

Ancient Sinhala Numeral Systems Discovered from Palm-leaf Manuscripts in Sri Lanka

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ABSTRACT

Counting is as old as human civilizations and different numbering methods have been indigenous to respective cultures and lands. Until the modern numeric system was introduced, people successfully adopted their own numbering methods, which were used for many millennia. Hence, this study was undertaken as an explorative research project to find out (objective) how ancient monasteries in Sri Lanka indexed and organized the palm-leaf manuscripts in the pre-modern numeric period. In this regard, Sinhala numerals have special linguistic and logical ties with local communities, thus those numbers in the manuscripts are important in indexing and cataloguing the resources. Sri Lanka has historically used (and still uses, to extent) its own numeric system in its ancient palm-leaf manuscripts both in Sinhala and Tamil literary work. This research mainly focused on Sinhala palm-leaf manuscripts preserved in selected Buddhist monasteries in Sri Lanka.

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Since this was a qualitative research study carried out for three years, involving observation with the assistance of specialists, there was no predefined population to mention, hence, all the manuscripts available in the study areas were taken into consideration. Manual textual analysis of 4,568 manuscripts unveiled five different types of Sinhala numerals corresponding to different timelines, and disclosed the evolution of number system through various reigns. The numeral systems discovered through this study are Sinhala *illakkam*, *Lith illakkam*, *Pansal Hodiya*, Indo-Arabic numbers, and Tamil numbers. The Sinhala *illakkam* was the oldest numeral system found in palm leaf writings during 1754-1825 AD. It was specifically used for Pali and literary contents. The *Lith illakkam* was as old as Sinhala *illakkam* and was used for astrological and native medicinal content in palm-leaf manuscripts. The most prominent numeral system was *Pansal Hodiya*, which was later replaced by the Indo-Arabic numeral system, which took place gradually since 16th Century (Senevirathne, 2018). The Tamil numeral system was also identified. Digitalization process of palm-leaf manuscripts will be the next level of this study, which is crucial for information access and preservation of the palm-leaf manuscripts. Additionally, incorporating AI tools to analyze digitized materials could create new opportunities for future research in this domain, such as automated text detection and content analysis.

Keywords: Numeral Systems, Languages, Palm-leaf Manuscripts, Textual Analysis, Ola-leaf Manuscripts, Sri Lanka

Introduction

Buddhist monasteries and temples have been the custodians of numerous ancient manuscripts containing literature on spirituality, rituals, history, culture, medicine, and folklore of Sri Lanka. These manuscripts packed in palm-leaf bundles, contained different numeral systems corresponding to changing reigns and timelines in the island. The numeral systems reflected the linguistic and socio-cultural transformation of the region. Moreover, in the process of digitalization of palm-leaf manuscripts it is essential to recognize the numerals and special characters of it, especially when the sources are deteriorated, damaged, or even partially destroyed due to poor preservation methods. Therefore, exploration of the palm-leaf manuscripts is important in preserving the vulnerable material, developing their repository, and in indexing and organizing. During this three-year study, every palm-leaf was meticulously analyzed for their numeral system. Most importantly, such a study has not been carried out to this extent before to analyze the numeral system used in Sri Lanka.

Objectives

Investigating the significant and unique types of Sinhala numeral systems used in palm-leaf manuscripts in Sri Lanka was the primary objective of this study, along with the following specific objectives:

- To find out the evolution of Sinhala numerals used for pagination between different time zones, especially from 16th to 19th Century AD; and
- To identify the types of numerals used in palm-leaf manuscripts in Sri Lanka analyzed.

Literature Review

Over the past millennia, various number systems have evolved reflecting the cognitive abilities of civilizations, from ancient Mesopotamia and Egypt to India and the Modern World. The development of such arithmetic systems demonstrates the social and economic trends of those cultures. Meanwhile, the Roman and Greek number-systems, although not as efficient or convenient as others, offer unique historical perspectives on their scientific and legal development. During pre-modern numeric period, different cultures adopted their own systems of counting and performing mathematical operations (Lippman, 2020). Modern world adopted the Hindu-Arabic numerals where zero is a placeholder that led to a paradigm shift in numbering systems and calculations (Latif, 2023). Therefore, numerals of different cultures exhibit their connection to socio-anthropogenic and cognitive dimensions of respective cultures.

Sinha and Mishra (2023) point out that the Eurocentric view of arithmetic history has largely discounted the eastern hemisphere's mathematical development. This evinces the need to examine the local number systems and their connection to human development. The Sinhala number system has deep historical roots, evolving from early practices where humans distinguished "more" and "less" in daily tasks. Archaeological evidence suggests that the origin of counting in human civilization could be traced back to around 50,000 years. Over millennia, various number systems emerged, including those of the Egyptians, Babylonians, Hindus, Mayans, Romans, and the modern Western system (Ifrah, 2000). The development of counting is closely intertwined with the evolution of mathematics, which likely predates formalized number systems. Key milestones in mathematical progress such as

the measurement techniques of the Babylonians and Egyptians and the use of pattern recognition in prehistoric counting were foundational to the development of more complex systems of form, size, and quantity (Clarysse, 2006). LeVeque and Smith (2025) state that ancient cultures used sticks, pebbles, stones and pottery to maintain a record of counts since mathematics and taxations were not required in their simplest lives. These numerals later evolved into symbols and then modern numbers. Regardless of the forms, that those ancient people used, the numbering systems helped group and count things used in daily life.

Figure 1
Display of different number systems in Asia

Comparison of selected modern systems of numerals										
Hindu-Arabic	1	2	3	4	5	6	7	8	9	0
Arabic	١	٢	٣	٤	٥	٦	٧	٨	٩	٠
Devanagari (Hindi)	१	२	३	४	५	६	७	८	९	०
Tibetan	༡	༢	༣	༤	༥	༦	༧	༨	༩	༠
Bengali	১	২	৩	৪	৫	৬	৭	৮	৯	০
Thai	๑	๒	๓	๔	๕	๖	๗	๘	๙	๐

Note. From LeVeque & Smith (2025)

The evolution of number systems used among ancient and indigenous people reveal the development of their socio-cultural and economic aspects of human race. In this regard, exploration of local numerals helps identify the advancements in scholarship and tradition.

Likewise, Van Nooten (1993) discovered the *chandahsâstra*, or "science of verse meters" as a branch of the Indian binary system that immensely contributed to the today's computer programming. He also believes that *Piṅgala*, an ancient Indian scholar, used binary calculations in 2nd or 3rd BCE. However, the ancient eastern history of numbering systems did not receive sufficient attention from the western chronicles. This leaves a lacuna of historical records of indigenous numerals in the eastern hemisphere that includes Sri Lanka.

In Sri Lanka, it is believed that the writing and numbering systems had developed concurrently during the Anuradhapura period (සේනාරත්න, 2019). Ancient records, including the Pali chronicles like the *Mahāvamsa* (Great Chronicle) and the *Dīpavamsa* (History of the Island), suggest that both a spoken and written language were established as early as the 5th century BCE, following the arrival of Prince Vijaya from India. Historical evidence indicates that the Sinhalese people began using plant leaves as writing material around this time (De Silva, 1969). The evolution of these practices was significantly influenced by Venerable Mahinda Thero, who introduced the *Brāhmi* script to Sri Lanka and further promoted the literacy and the spread of Buddhist teachings. The first documented use of the palm leaf as a writing medium in Sri Lanka occurred in the 1st century BCE. Five hundred monks undertook the monumental task of inscribing the *Tripitaka* (Buddha's teachings) in Pali on talipot palm leaves at *Aloka Viharaya*, an ancient temple near Matale (Geiger, 1912). In such a voluminous literary task, it is necessary to have numbering and indexing systems that would ensure sequence and connection among those palm leaf manuscripts (Wijerathne, 1959).

Similarly, Mendis, Perera and Nonis (2023) found that excavated pottery and other artefacts containing ancient scripts were clear evidence to then social, cultural and economic status of the inhabitants. *Brāhmi* letters found on potsherds indicates references to the counterparts dug up in India, which speculates the trade and cultural connections between the two landmasses. Besides, the symbols and numbers demonstrated the evolution and impact of local number systems on linguistic and arithmetic development in Sri Lanka in the ancient times.

Moreover, Menninger (1992) expresses that number systems are closely knitted with linguistics and culture of society. Development of numerals to count and index literary work or otherwise demonstrates the evolution of ancient scholarship and transformation of economies. Therefore, it is paramount to explore the ancient Sinhala and Buddhist number system to record the history of counting and indexing used before the colonial periods.

Research Design and Methods

The study employed qualitative research method where observation and textual analysis applied to palm-leaf manuscripts found from selected temples and monasteries located in the western and southern strip of Sri Lanka. Textual analysis (archival communication research of verbatim recordings, in this case, the palm-leaf manuscripts) involved descriptive, analytical, interpretative, and evaluative stages. The content analysis is one of the types of textual analysis, which was applied in this research (Hawkins, 2017). Incidentally, necessary assistance from experts in Pali and ancient scripts were also sought when ambiguities arose about symbols and letters.

The researchers, who have the necessary knowledge and skills in documentary research, surveyed the selected temples located in Western, Northwestern, and Southern Provinces of Sri Lanka. The following temples were included in the investigation:

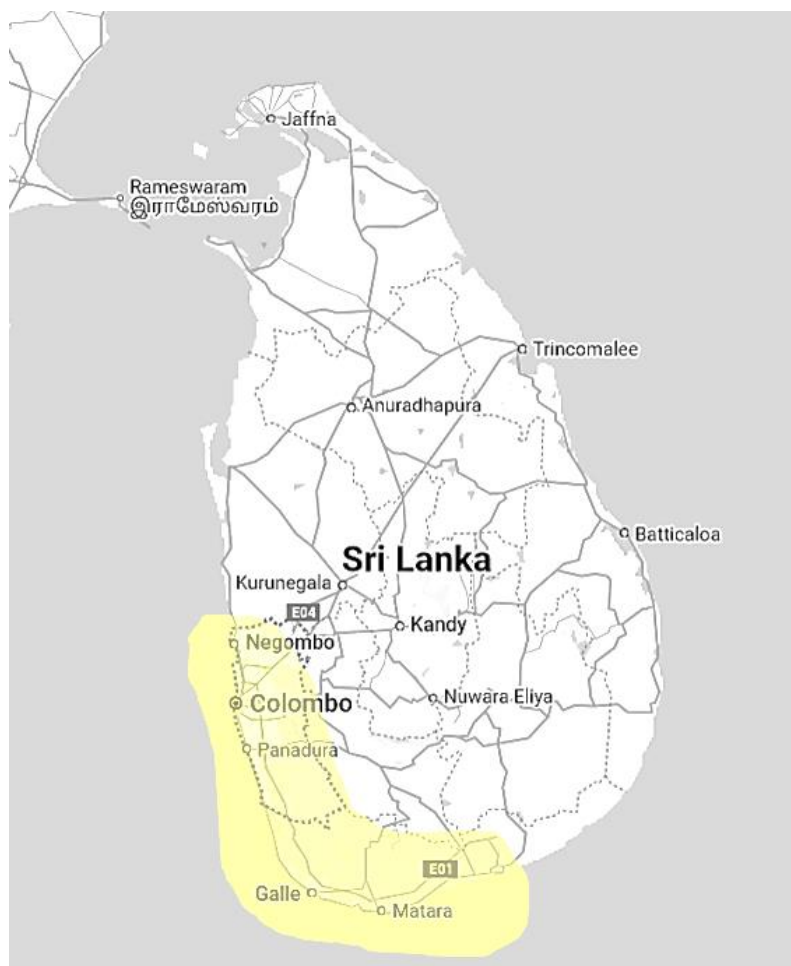
Table 1

Monasteries and corresponding number of manuscripts

Name of the Monastery	No. of Records
Kumara Kanda Rajamaha Viharaya, Dodanduwa	627
Ethkanda Rajamaha Viharaya, Kurunegala	780
Nikawewa Raja Maha Viharaya, Nikawewa	531
Ginipenda Viharaya, Kalugamuwa	532
Madawala Shilabimbaramaya, Madawala	235
Viharegama Raja Maha Viharaya, Narammala	350
Vidyananda Piriwena, Nittambuwa	390
Vidyalankara Pirivena, Kelaniya	480
Bothale Raja Maha Viharaya, Mirigama	425
Purana Mirigama Viharaya, Mirigama	218
Total	4,568

Figure 2

Monasteries selected in the Western, Northwestern & Southern Provinces



Note. From Google. (n.d.), <https://maps.app.goo.gl/UG3J8QbJYdZhp2xX9>

Having meticulously analyzed 4,568 palm leaf manuscripts for approximately three consecutive years, using textual interpretation and comparison (content analytical type), the researchers identified the special types of Sinhala number system used in palm-leaf manuscripts maintained by those temple monasteries.

Results and Discussion

After a meticulous analysis of numbers used in each leaf, the researchers identified five distinct numbering systems through those palm leaf manuscripts: namely, Sinhala *Illakkam* (සිංහල ඉලක්කම්), also known as Sinhala archaic numbers, *Lith Illakkam* (ලිත් ඉලක්කම්), or ephemeris numerals, *Pansal Hodiya* (පන්සල් හෝඩිය) (also known as the alphabet of the temple), Hindu-Arabic numerals and Tamil numerals. The *Pansal Hodiya* system was further categorized into two types:

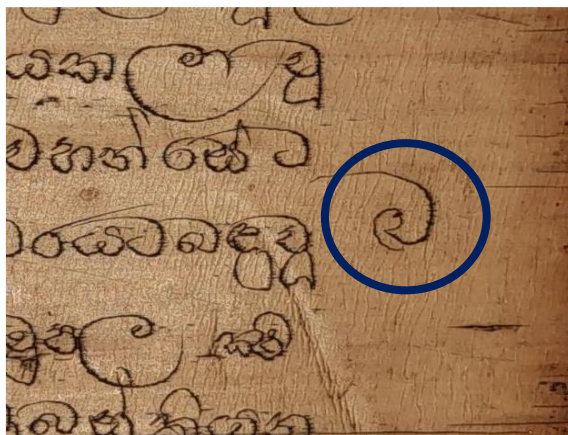
Pansal Hodiya Type 1: This was the most common numeral system, based on Sinhala characters according to the order of consonants and vowels in the Sinhala alphabet, excluding two vowel characters. The sequence began with 'Ka' (ක), and the number of combinations that could be formed from the consonants amounted to 544. Once the first 544 reached completion, the numbering would cycle back, starting with the word 'Dwi/Dvi' (ද්වි), meaning "second," in English. If the second cycle did not end the palm leaf book, the third cycle would begin, starting with the word 'Thri/Tri' (ත්‍රි).

Pansal Hodiya Type 2: This method was similar to Type 1 but included vowels in the sequence, beginning with 'A' (අ) and 'Ae/Aa' (ආ).

The next numeration system identified is known as *Katapayadia* (කටපයාදිය), which was primarily used for inscribing the dates of palm-leaf manuscripts (Raman, 1997). In this system, numbers were assigned to specific Sinhala letters (Figure 3). The images of the palm-leaf manuscripts were captured by the researchers during the study.

Figure 3

Sinhala Illakkam (encircled in the image)



Note. Photographed by the researchers

Additionally, Indo-Arabic and Tamil numerals were also used for numbering palm-leaf manuscripts. These numerals were typically inscribed on the left-hand corner of the folios, though in some instances, they were found on both sides. A selection of manuscripts, dated between 1754 AD and 1974 AD, was examined for the location and the type of numerals that were inscribed. Traditionally, the compilation date of a manuscript was inscribed on the last folio; however, this tradition was inconsistently followed, with the date present in only 11% of the total manuscripts studied. Regarding the *Sinhala Illakkam* system, it was observed on manuscripts dated between 1754 AD and 1825 AD, representing 9% of the total manuscripts studied (Figure 4).

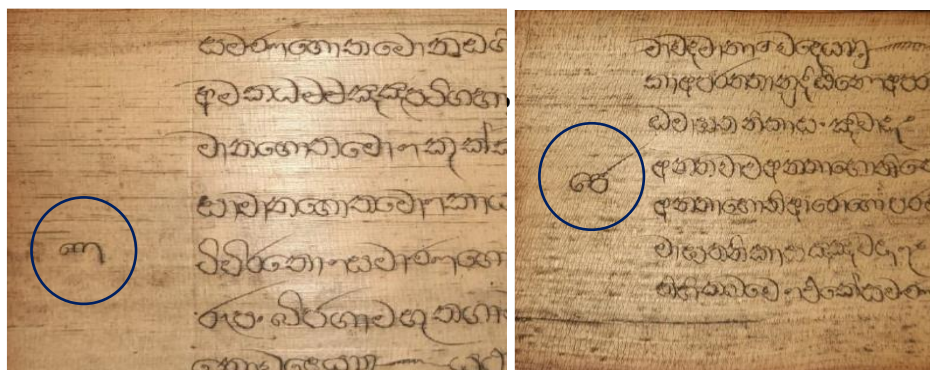
Interestingly, 3% of the manuscripts employed both the *Sinhala Illakkam* and *Lith Illakam* systems, with each method being used in different sections of the same manuscript. This suggests that *Sinhala Illakkam* was the most ancient numbering method, followed by the use of *Lith Illakam*, and later, the *Pansal Hodiya* system.

Table 2
Types and Chronology of Sinhala Numbers

Numbering system	Year
Sinhala <i>illakkam</i>	1754-1825 AD
Combination of <i>Lith illakam</i> and Sinhala <i>illakam</i>	Beginning of 1800s AD
Combination of Sinhala <i>illakkam</i> and <i>Pansal Hodiya</i>	After 1820 AD

The *Lith Illakkam* system was found only in 15% of the sample. The subjects of these manuscripts were quite limited, with 95% of the samples using *Lith Illakkam* primarily for astrology, while the remaining manuscripts focused on native Sinhala medicine (Figure 5).

Figure 5
Lith Ilakkam



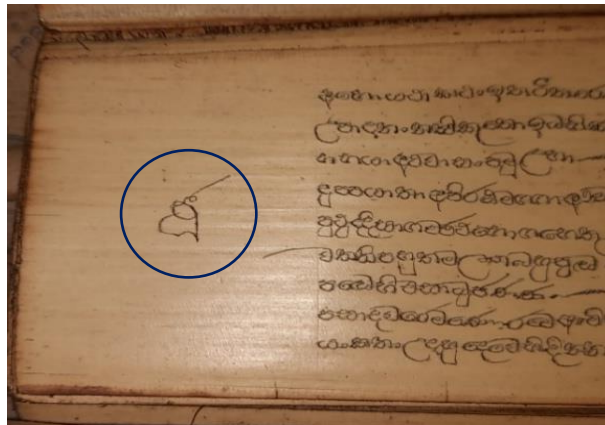
Note. Photographed by the researchers

Pansal Hodiya Type 1 was the most common numbering system identified in this study, found in palm-leaf manuscripts dated from 1820 to 1974, representing 85% of the selected sample. The following numbering pattern was observed: Typically, the numerals were inscribed on the right side of the folio (Figure 6). After the first 544 pages, the second cycle of numbering was indicated by inscribing "De" (දෙ, පුනර්) or "Dwi" (ද්වි) (Figure 7 and 8)

before the consonant characters. The third cycle began with the character "Thri" (ඡ්‍රි). In some rare instances, the same letter was inscribed twice to indicate the second cycle, and three times for the third cycle (Figure 9).

Figure 6

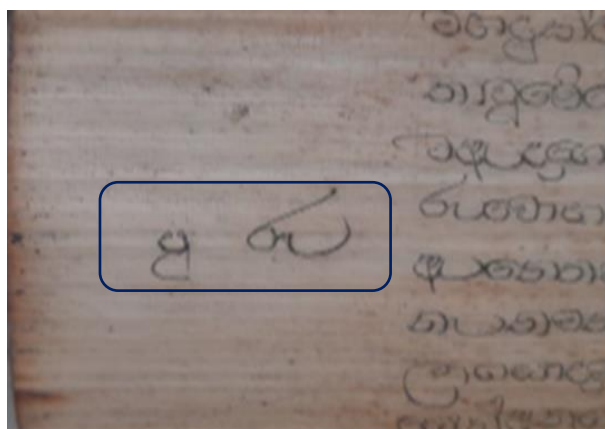
Numbering on the left side of the folio



Note. Photographed by the researchers

Figure 7

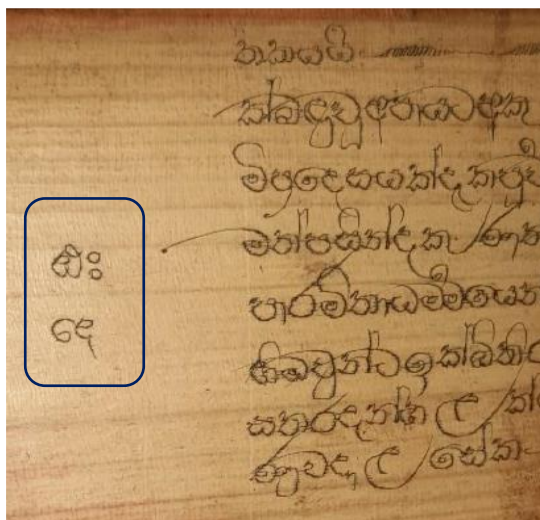
Second cycle of numbering (ඡ්‍රිඡ්‍රි)



Note. Photographed by the researchers

Figure 8

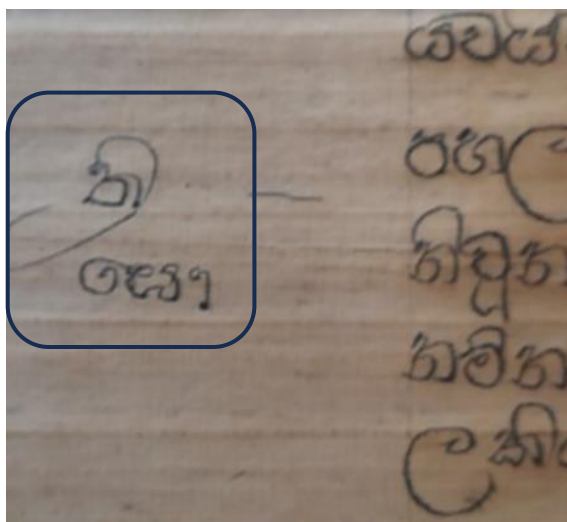
Second cycle of numbering (ද්වි)



Note. Photographed by the researchers

Figure 9

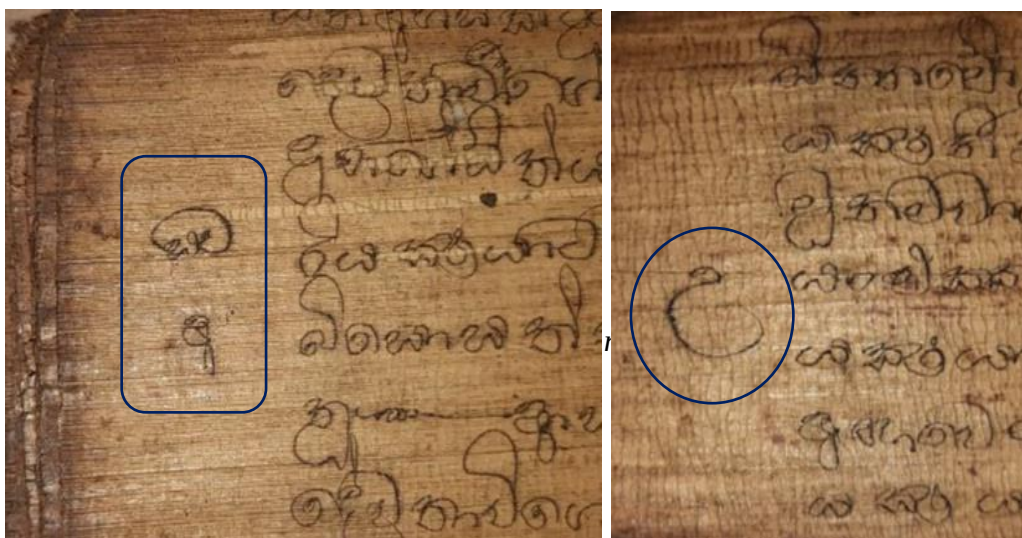
Third cycle of numbering (ත්‍රි)



Note. Photographed by the researchers

Of the total collection inspected, 10% of the manuscripts used the *Pansal Hodiya* Type 2 numbering method. In this system, numbering began with the vowel character "Ae" (අ), as seen in the *Wadan Kavi Pothe Hodiya* (Left side image in Figure 10).

Figure 10
Pansal Hodiya type-2



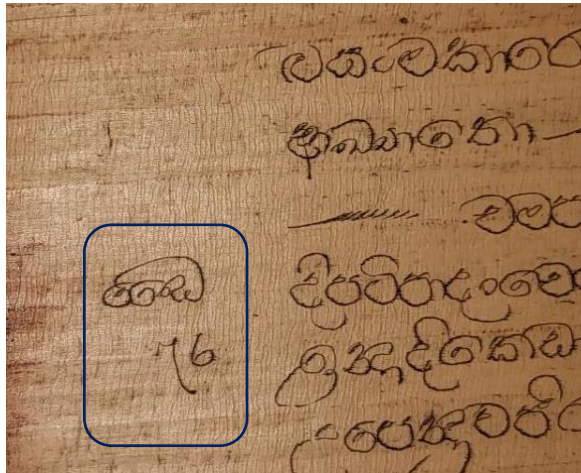
Note. Photographed by the researchers

Various patterns were observed during the study. Both the *Pansal Hodiya* and Arabic numeral systems were used for numbering in 4% of the sample. In most cases, the *Pansal Hodiya* system, with Sinhala characters, appeared at the top left of the folio, while the Arabic numeral was inscribed directly beneath it on the same side (Figure 11).

Additionally, in six manuscripts, the *Pansal Hodiya* numbering was inscribed on the left side of the folio whereas the Indo-Arabic numeral was on the right side of the same folio (Figure 12).

Figure 11

Pansal Hodiya and Indo-Arabic numeral



Note. Photographed by the researchers

Figure 12

Pansal Hodiya on left side (circled) and Arabic numeral on right side (squared)



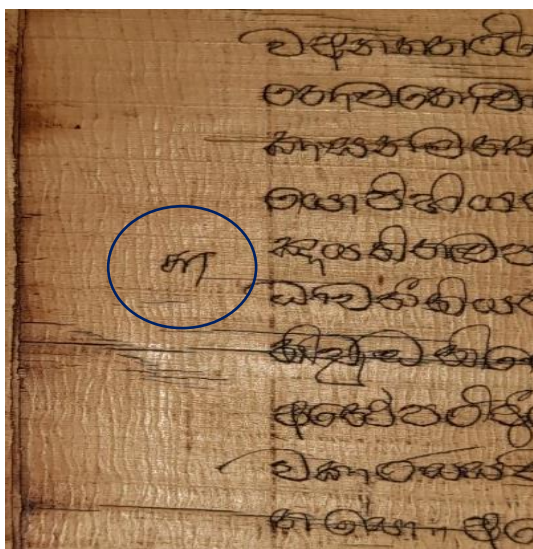
Note. Photographed by the researchers

Twenty (20) percent of the sample used the Arabic numeral system. In most cases, the Arabic numerals were inscribed on the left side of the folio, though in some instances they appeared on the right side. Most of these

manuscripts were Buddhist literature produced after 1950s. In some cases, palm leaf manuscripts from the same period were numbered using Tamil numerals, which were also seen on the left side of the folio (Figure 13).

Figure 13

Tamil numbering



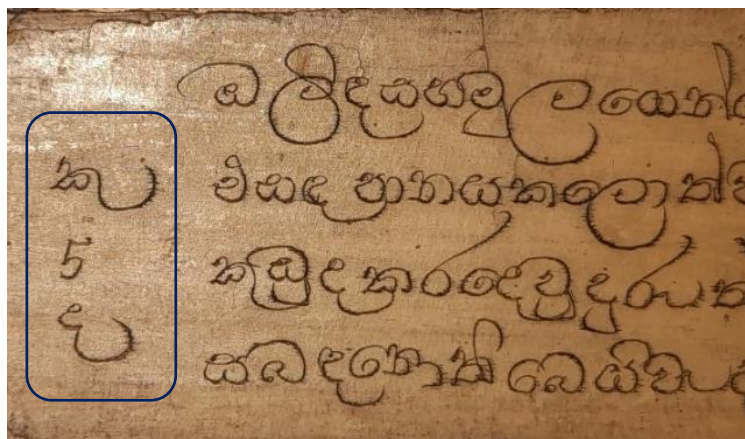
Note. Photographed by the researchers

In rare instances, two palm leaf manuscripts from 1920 were found to feature a combination of three numeral systems: Pansal Hodiya Type 1 at the top, Arabic numerals in the middle, and Lith Illakkam at the bottom, all inscribed on the left side of the same folio (Figure 14).

During the study, five distinctive numeral systems were found to have been used for numbering the palm leaf manuscripts of Sri Lanka: Sinhala *Illakkam*, Lith *Illakkam*, *Pansal Hodiya* (which existed in two types), Arabic numerals, and Tamil numerals. In some cases, combinations of two or even three numeral systems were used.

Figure 14

Three numbering systems



Note. Photographed by the researchers

Sinhala *Illakkam* was primarily used for numbering the oldest palm leaf manuscripts in the sample. The Lith *Illakkam* system was also in use during the same period, particularly for manuscripts related to astrology. With the introduction of the Sinhala mixed alphabet, inscribers began using *Pansal Hodiya* for numbering after the 18th century. Later, influenced by Western practices during the colonial period, the Arabic numeral system gradually replaced the traditional systems.

Conclusions

The findings indicated that several numeral systems have been used for palm leaf manuscripts over time, depending on the content of the manuscript. The numeral systems discovered were Sinhala *Illakkam*, Lith *Illakkam*, *Pansal Hodiya* (Type 1 and 2), the Arabic numeral system, and the Tamil numeral system.

According to the findings, it was clear that Sri Lanka had its own unique numeral system known as Sinhala *Illakkam*. The oldest palm leaf manuscript in the sample featured this numeral system, which dates back to the 16th Century AD. Sri Lanka also had another unique numeral system used alongside Sinhala *Illakkam*, called *Lith Illakkam*. During the mid-1900s, with the evolution of the modern Sinhala alphabet, *Pansal Hodiya* replaced the ancient numeral systems. Later, with the influence of Western nations during the colonial period, the Arabic numeral system was used for palm leaf manuscripts.

The content and numeral systems are interconnected. The ancient Sinhala *Illakkam* was predominantly found in Pali literature and native medicinal palm leaf manuscripts. *Lith Illakkam* was used exclusively for astrological purposes, and it was seen in palm-leaf manuscripts on astrology. Later, *Pansal Hodiya* was introduced along with the modern Sinhala alphabet, and appeared especially in Buddhist and Pali-Sinhala literature palm leaf manuscripts.

There was limited recorded evidence on Sinhala numbering system and its influence on local arithmetic and linguistic development in the ancient Sri Lanka. Prior to the European invasion, the local scholars used indigenous writing materials, especially palm leaves to record various genres of knowledge. The palm-leaf manuscripts examined in selected Buddhist monasteries and temples in Sri Lanka had followed unique number systems that evolved over centuries. The connections of these numbers to the intellectual contents of the palm-leaf manuscripts should be investigated extensively. Moreover, digitalization of palm-leaf manuscripts ensures the accessibility to these resources and their preservation in the electronic

environment. When digitalizing the palm-leaf manuscripts, letters representing numeric glyphs and Sinhala characters require special attention as they need to be properly identified and incorporated into Artificial Intelligence (AI) tools. Extensive research on digitalizing this valuable heritage with the help of AI tool is recommended for future studies. Therefore, future research utilizing AI and glyph recognition tools is highly encouraged.

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