On The Javanese Ethnoastronomy: Time Dimension on the Calendrical Inscriptions on Majapahit Era until Now

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Abstract. The Saka calendrical inscriptions recorded the time journey in its own specific way, such as the use of suklapaksa and kresnapaksa, equipped with saptawara, pancawara and sadwara day names. At the next stage, it is added with wuku. During the Majapahit era, the time dimensional recording was expanded to include such elements as naksatra, yoga, karaṇa, muhūrta, devatā, grahacāra, parwesā, maṇḍala, and rāśi. This article traces the journey of usage of these time dimensions and completes it with the sculpture samples in some inscriptions from Majapahit era or after, and proposes it as the archipelago’s ethnoastronomy.

1. Introduction
According to Wiramihardja [5], ethnoastronomy is the expression of an ethnic regarding their perception towards the universe and the influence and practical use of astronomical knowledge in daily life, such as in calendar system. In ethnoastronomical research, the archipelago’s cultures related to astronomy can be traced. One of the data types recorded by inscriptions and used as ethnoastronomical study is the time dimension in the form of the inscription dating.

Tracing the calendar system from the oldest to the most recent ones enables the disclosure of information on many things clearly. Some of this information includes (1) the calendar system once used in the archipelago, and (2) the system or method of naming time in reference to astronomical objects. In this paper, both will be presented by giving examples of inscriptions containing them.

Prabowo, Sugandha and Tripena [3] have examined the time dimension in the form of calendar elements in yupā and inscriptions from Tarumanegara, Srivijaya, and Old Mataram. In this paper, additional results will be elaborated regarding some things related to astronomy such as the naming of time and Javanese calendar. The elements of calendar in inscriptions from Majapahit era or later will also be traced.

2. Methods
This research is conducted using literature study and field study methods. The field study is done by finding and visiting historical sites.
2.1 Method of Collecting Data
Many of the literature used in this research are historical archives or texts related to inscriptions in the Archipelago. Thus, the data used are secondary. While the inscriptions are written in letters and languages which are currently infrequently used, this research finds no substantial difficulties. Historians have read and translated these inscriptions into both Indonesian and English. The field study is done to make some documentations in the form of photographs.

2.2 Method of Data Analysis
The data collected are inscription texts in their original letters, such as Palawa letters, Old Javanese letters, Majapahit letters, New Javanese letters, and so forth. The languages used to write the inscriptions include Sanskrit, Old Javanese language, New Javanese language, and so on. To each of these texts, a translation in Indonesian language written in latin letter is provided, and when possible the original quote of the inscriptions is added.

The collected data are then processed by sorting the texts containing time dimension. Hence, the method of analyzing the data is the qualitative one.

3. Results and Discussion
3.1 Lingga: Astronomical Object to Measure Shadow’s Length
The presence of name or characteristic of time cannot be separated from the great efforts exerted by Javanese people in maintaining their harmonious relations with the universe. One of their ways of finding out the change in time or moment is using a simple object called as lingga, i.e. a stone stake planted upright in the middle of a vast, plain yard (figure 1). The Javanese and Sundanese people use this lingga as an astronomical object to serve the same function as gnomon, i.e. to measure the length of its shadow during daytime. One of the units used to measure the shadow’s length is pecak or palm, i.e. the length of human foot from heel to big toe.

I-Tsing was a Buddhist priest from China who travelled from Canton to Palembang. He used himself as a lingga or gnomon and said that in his journey he had reached a city situated right under the horizon’s shadow. When he stood upright at midday under the sun he saw no shadow of himself. Based on the current astronomical knowledge, this city should be located right at the equator line, and that is only possible on March 21 or October 23.

3.2 Astronomical Bases behind Calendar
According to Wiramihardja [5, 6], any society with astronomical knowledge will pay thorough or partial attention to the following things in their daily lives: (1) use of time marker, (2) use of calendar, (3) investigation into the moon and the sun, and (4) use of pranata mangsa.

Meanwhile, Sundanese has long been familiar with something related to stars, the sun and the moon [5]. The same applies to Javanese. This indicates that the earth and the sun have known as astronomical objects by both ethnics. Javanese and Sundanese people made the sun as a day name in their 7-day cycle, namely Radite or Dite (Sunday).

Figure 1. Lingga and gnomon
Source: http://legendabanten.blogspot.co.id/2013/03/asal-muasal-batu-lingga.html
https://www.eso.org/public/outreach/eduoff/seaspace/docs/navigation/navastro/navastro-7.html
Almost all regions in Indonesia have their own calendar systems which generally use the sun and/or the moon as their bases. The names of day in Saka Calendar system used by Javanese people were influenced by India. Those names of day used Sanskrit (Table 1 and Table 2 column (3)). When the influence of India faded and was replaced by Arabian influence, the names of day changed into Ahad, Senen, Selasa, Rebo, Kemis, Jemluah and Setu (Table 2 column (4)).

The introduction of sky objects to Javanese people can be traced from their calendar format. This introduction of such objects took place gradually and reached its peak during the Majapahit era. Before the Majapahit era, there were five elements of calendar namely tithi (date) with its bright and dark halves (suklapaksa and kresnapaksa respectively), month name, saptawara, sadwara, and pancawara day names. In Majapahit era, the number of calendar elements increased to fifteen.

The use of saptawara day names in Sanskrit shows that astronomical objects had been known by Javanese people (Table 1). At least, six planets were known, they were Mercury, Venus, the Earth, Mars, Jupiter and Saturn.

| No | Saptawara day name | Astronomical objects |
|----|-------------------|----------------------|
| 1  | Radite (Sunday)   | Sun                  |
| 2  | Soma (Monday)     | Moon                 |
| 3  | Anggara (Tuesday) | Mars                 |
| 4  | Buda (Wednesday)  | Mercury              |
| 5  | Respati (Thursday)| Jupiter              |
| 6  | Sukra (Friday)    | Venus                |
| 7  | Tumpak or Santscara (Saturday) | Saturn |

### 3.3 Inscription Calendrical Format
The observation of the moon and the sun resulted in conclusion that there were moon-day and sun-day with different duration hence two calendar systems emerged, the moon-based (lunar system) and the sun-based (solar system) ones. The observation of the moon and the sun gave birth to Saka calendar of luni-solar nature because this calendar combined the lunar and solar systems.

The observation of the moon inspired them to divide the days in a month into two parts, the bright and dark parts. The Saka calendar used a concept of bright and dark parts called suklapaksa and kresnapaksa and its application was found in all inscriptions which used Saka calendar.

According to Boechari [1], the elements of Javanese inscription in sequence are (1) appeal, (2) dating, ......, (16) citralekha inscription. The second element, i.e. dating, is the one requiring investigation ethnoastronomically.

The dating format of the Archipelago’s inscriptions included date in suklapaksa and kresnapaksa forms, month and year number in the Saka Calendar, equipped with three types of day namely the names of saptawara, pancawara and sadwara days (Table 2 column (1), (2), and (3)). The year number used was usually in the form of numbers or sengkala lamba [8].

From the three types of day, the first one to occur was saptawara, as found in the Canggal Inscription (654 Saka or 632 AD), i.e. soma day or Monday [3]. The sadwara and pancawara day names appeared simultaneously in Manjusrigraha Inscription (714 Saka or 792 AD) which also specified the saptawara day, namely sukra, was, and pon.

The more later calendar format was equipped with the addition of wuku, i.e. a time cycle lasting for seven days and forming pawukon calendar. The complete names of this wuku were sinta, landep, wukir, krantil, tulu, gumbreg, wariga ning wariga, wariga, julung, julung sungsang, duiulan, kuniyan, laikir, madasidha, julung pujut, pahang, kuru wlut, marakih, tambir, mandañkuñan, maha tál, wuyai, manahil, prang bakat, bala (muki), wugu-wugu, wayang-wayang, kulawu, dukut dan watu gunung [4].
Thus, the pawukon calendar contained 30 wuku with its 210-day duration. Meanwhile, a pawukon year had 60 wuku or 420 days.

Table 2 Elements of inscription calendrical from Java

| Pancawara days on Javanese Calendar | Sadwara days on Javanese Calendar | Saptawara days on Javanese Calendar | Asawara days on Javanese Calendar | Sangwara days on Javanese Calendar | The Name of Month on Saka Calendar | The Name of Month on Javanese Calendar |
|-------------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-----------------------------------|------------------------------------|---------------------------------------|
| Saka 1                          | Saka 2                          | Saka 3                             | Saka 4                           | Saka 5                           | Saka 6                           | Saka 7                               |
| 1. Manis/Legi                   | 1. Tungle                       | 1. Radite                          | 1. Sri                           | 1. Dangu                         | 1. Swarna                        | 1. Sura                               |
| 2. Paing                        | 2. Aryan                         | 2. Senen                           | 2. Indra                         | 2. Jagur                         | 2. Bhadrawada                     | 2. Sapur                              |
| 3. Wage                         | 3. Wurukung                      | 3. Anggara                         | 3. Guru                          | 3. Giris                         | 3. Asuji/Aswina                  | 3. Muluk                              |
| 4. Kliwon                       | 4. Paningron                     | 4. Buda                            | 4. Yama                          | 4. Kerongan                     | 4. Karika                         | 4. Bakdamulud                         |
| 5. Mawulu                       | 5. Uwas                         | 5. Reputi                          | 5. Rudra                         | 5. Nohan                         | 5. Margasira                      | 5. Jamadilawal                        |
| 6. Wurukung                     | 6. Sakra                         | 6. Jemawah                         | 6. Wogan                         | 6. Posya                         | 6. Jumadilakir                    | 7. Rajabh                            |
| 7. Tumpak                       | 7. Tapak                         | 7. Kala                           | 7. Talus                         | 7. Magha                         | 7. Rajabh                         |                                      |
| 8. Uma                          | 8. Wurgung                       |                                  | 8. Phalgana                      | 8. Purnawha                      | 8. Sona                           |                                      |
| 9. Dadi                         |                                  | 9. Dadi                           | 9. Caira                         | 9. Caira                         | 9. Caira                         |                                      |
| 10. Waisaka                    |                                  | 10. Waisaka                        | 10. Pusa                         | 10. Pusa                         | 10. Pusa                         | 11. Jyestha                           |
| 11. Jyestha                    |                                  | 11. Jyestha                        | 11. Dukangadide                  | 11. Dukangadide                  | 11. Dukangadide                  | 12. Asudha                           |
| 12. Asudha                     |                                  | 12. Asudha                        |                                  |                                  |                                  | 12. Besar                            |

The use of wuku name was first found in the Sang Hyang Tapak Inscription (952 Saka) which was used by Sundanese people from West Java. The next use of wuku name was found in the Pandak Badung inscription from Bali which contained 993 Saka year. And the inscriptions from Java which first inscribed the wuku name was the Pakis Wetan Inscription (1188 Saka). Below is a quote from the Sang Hyang Tapak Inscription.

**Quote of Sang Hyang Tapak Inscription (952 Saka Year)**

//O// Swasti shakawarsatita 952 karttikamasa tithi dwadashi shuklapaksa. ha. ka. ra. wara tambir.

Happy, to have safely passed 952 Saka year, karttika month, the 12th day of bright half (shuklapaksa), day ha.(haryang) ka.(kaliwuan/kliwon) ra.(radite)(wuku) tambir.

The next calender elements were yoga and naksatra. Yoga is the time during the simultaneous movement of the moon and the sun at 13°20’ position [9]. In one time the moon revolving the earth there are 360° : 13°20' = (360 x 60) : ((13 x 60) + 20) = 21,000 : 800 = 27 yogas. One yoga is 0.94118 day. Thus, the 27 yogas require 25,420 days [4]. The names of all yogas are wiskambha, priti, ayyusman, sobhaga, sobana, atiganda, sukarman, dhrti, sula, ganda, wddhi, dhruwa, wyatigata, harsana, bajra, sidhi, wyatipati, warayan, parigha, siva, sidha, sadya, subha, sukla, brahma, indra, and waidhrti [4].

Naksatra is a star or a solid object in the space, constellation passed through by the moon, the moon space [9]. There are 27 naksatras in one cycle, namely aśvini, bhaṣarī, krtikkā, rohini, mrgasiras, ārdra, purmnāśa, puṣya, aślesa, magha, pūrva phalguni, utara phalguni, hasta, citrā, śvati, viśakha, anurādhā, jyeṣṭha, mūla, pūrvāśādha, uttarāśādha, sṛvāṇa, dhanisītha, satabhiṣaj, pūrvādbhravdha, uttarādbhravdhā, and rewati [2].

During the Majapahit era, this inscription dating system continued to develop until one by one advancement in astronomy which measured precisely if the day was on what star constellation, day, month, year, date, what planet passed through, in what shape the moon at the time and et cetera. The elements developed further were the influence from India, namely karana, mührta, dewatā, grahamā, parweṣā, maṇḍala, rāśi.

One example of inscriptions from Majapahit era completely containing all elements of calendar was the Kudadu Inscription. The Kudadu inscription was dated 1216 Saka or September 11, 1294 AD. The sentences in the Kudadu Inscription were engraved in Kawi (Old Javanese) letters specifically called as Kawi Majapahit letters (figure 2). The Kudadu Inscription was a tamra praśasti type because it was
made from metal. This inscription issued by Raden (Prince) Wijaya was engraved on a copper plate. This inscription had been translated by J.L.A. Brandes. A copy of the Kudadu Inscription was also included in History of Java Vol. II by Thomas Stanford Raffles.

The Kudadu Inscription had nine lines, from B1 to B9. The transliteration of the Inscription Kudadu from Kawi Majapahit to Latin letters was not provided in Raffles’s book. The transcription of Kudadu Inscription move from [2]:

- **B1**: //0// svasti śakawarsātīta '1216' bhadrāpāda māsa 'tiθi pañcā
- **B2**: mi kṛṣṇapāṣa 'ha ' u ' śa 'wāra maṇḍākaṇān' bāyābha sīhagrahacāra'
- **B3**: rohini naksatra 'prajāpati dewatā 'mahendra maṇḍala'
- **B4**: siddhi yoga 'werajya mūhārta 'yama parweśa 'tetila karana'
- **B5**: kanya rāṣi 'irika diwasanyajnā śrī mahāvīratameswārānanditapara
- **B6**: kramottāṅgadeva' mahābana sapatnādhipavinaka karana 'śilā
- **B7**: cāra guṇa rūpavinvayotta manuyuktta 'samasta yawadviपेśvarā'
- **B8**: sakala sujana dharma saṃ rākṣaṇa 'narasihmahagadharhmaviśeṣa santa
- **B9**: na 'narasiṃhamārti sutātmaja 'kṛtanaga....

Just as the recently common writing in general, this Kudadu Inscription also specified the date, month and year of its writing at the beginning of sentences. The first line (B1) specified the year number in Saka calendar, i.e. 1216 (figure 3), the month name in Saka Calendar namely bhadrāpāda which was equipped with a date of the fifth day of dark half (tiθi pañcāmī kṛṣṇapāṣa) or the 20th day in B1 – B2.

**Figure 3.** The year number in Saka calendrical 1216 with Kawi Majapahit letters

Furthermore, the fifteen elements of calendar which included saptawara, pancawara, sadwara, naksatra, yoga, karaṇa, wuku, mūhūrta, yoga, nakṣatra, dewatā, grahacāra, parweśa, maṇḍala, and rāṣi were traced for their existence in B2 to B5.

The saptawara, pancawara, and sadwara day names can be traced in B2, written as abbreviations ha ' u ' śa 'wāra which means haryang (sadwara), umanis (pancawara) and saniscara (saptawara) day. The wuku name was also engraved in B2, i.e. wuku Medangkungan, followed by grahacara: boyabyastha (B2). See Table 4.

In the Javanese calendar, the saptawara day names and month names were changed (Table 2 columnn (4) dan (8)), and the sadwara, pancawara dan wuku day names were retained. The inscriptions which had used the Javanese calendar also omitted such elements as naksatra, yoga, karaṇa, mūhūrta,
dewatā, grahacāra, parweśa, maṇḍala, rāśi yet the use of astawara and sangawara days were added (Table 2 column (5) dan (6)).

4. Conclusion
The archipelago’s inscriptions used Saka and Javanese calendars in recording the time journey. Prior to the Majapahit era, the elements of calendar used included year in Saka calendar, tithi in suklapaksa and kresnapaksa formats, month name, and saptawara, sadwara dan pancawara day names, and wuku. During the Majapahit era, the elements of calendar were added, including naksatra, yoga, karaṇa, muhūrtā, dewatā, grahacāra, parweśa, maṇḍala, rāśi.

Table 3. Calendrical elements on Kudadu Inscription

| No | Elements | Name             | Location |
|----|----------|------------------|----------|
| 1  | Masa     | Bhadrapāda       | B1       |
| 2  | Tithi    | Pañcami kṛṣṇapakṣa | B1-B2   |
| 3  | Sadwara  | Haryang          | B2       |
| 4  | Pancawara| Umanis           | B2       |
| 5  | Saptawara| Saniscara        | B2       |
| 6  | Wuku     | Medangkungan     | B2       |
| 7  | Grahacara| Boyabyastha      | B2       |
| 8  | Naksatra | Rohini           | B3       |
| 9  | Dewata   | Prajapati        | B3       |
| 10 | Mandala  | Mahendra         | B3       |
| 11 | Yoga     | Siddhi           | B4       |
| 12 | Muhurta  | Wairāja          | B4       |
| 13 | Parwesa  | Yama             | B4       |
| 14 | Karana   | Tetila           | B4       |
| 15 | Rasi     | Kanya            | B5       |

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