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Saadoe'ddin Djambek's Thoughts on Calculating the Beginning of the Hijri Month

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Abstract

The determination of the beginning of the Hijri month is important for Muslims as the basis for performing several religious rituals. There are two major schools of thought that are the source of debate in determining the beginning of the Hijri month, namely the rukyat school and the hisab school. Hisab is divided into hisab urfi and hisab hakiki. *Hisab hakiki* is further categorised into hisab *hakiki taqribi*, hisab hakiki tahqiqi, and hisab hakiki kontemporer. One of the data sources for hisab hakiki kontemporer is the Nautical Almanac, which was first developed in Indonesia by Saadoe'ddin Djambek as one of the innovators in hisab thought. One of the ideas proposed by Saadoe'ddin Djambek is the renewal of the calculation of the beginning of the Hijri month. This paper will discuss the calculation of the beginning of the Hijri month in Saadoe'ddin Djambek's thinking. This research is a literature review with primary data sources from Saadoe'ddin Djambek's writings and secondary data sources from other writings related to this theme. The data collection method involves documentation, with data analysis using content analysis techniques. The research indicates that Saadoe'ddin Djambek's approach to calculating the beginning of the Hijri month is a contemporary method, and his data and methodologies play a significant role in determining the onset of the month. The theory of the calculation of the beginning of the month proposed by Saadoe'ddin Djambek provides a relatively new foundation for thinking about the calculation of the beginning of the month at that time, as it is derived from an integrated understanding between experts in calculation and experts in astronomy. Saadoe'ddin Djambek's calculation method is among those whose accuracy is not significantly different from other methods of calculating the beginning of the month, such as the Ephemeris system. Therefore, this method remains viable for use despite being proposed in the 1970s.

Keywords: The Calculation, Hijri Calendar, Contemporary, Saadoe'ddin Djambek.

Abstrak

Penentuan awal bulan Hijriah penting bagi umat Islam sebagai dasar pelaksanaan beberapa ibadah. Ada dua mazhab besar yang menjadi sumber perdebatan dalam penetuan awal bulan Hijriah yaitu mazhab rukyat dan mazhab hisab. Hisab terbagi menjadi hisab urfi dan hisab hakiki. Hisab hakiki dikelompokkan menjadi hisab hakiki taqribi, hisab hakiki tahqiqi, dan hisab hakiki kontemporer. Salah satu data hisab hakiki kontemporer adalah data Almanak Nautika yang pertama kali dikembangkan di Indonesia oleh Saadoe'ddin Djambek sebagai salah satu pembaru pemikiran hisab. Salah satu pemikiran yang digagas oleh Saadoe'ddin Djambek adalah pembaruan hisab awal bulan Hijriah. Tulisan ini akan membahas hisab awal bulan Hijriah dalam pemikiran Saadoe'ddin Djambek. Penelitian ini adalah penelitian pustaka denga sumber data primer tulisan karya Saadoe'ddin Djambek dan sumber data sekunder berupa tulisan lain yang berkaitan dengan tema ini. Metode penggalian data berupa dokumentasi dengan teknik analisis data berupa analisis konten. Penelitian menunjukkan bahwa pemikiran hisab awal bulan Hijriah Saadoe'ddin Djambek termasuk hisab kontemporer dengan berbagai data dan metodenya mempunyai peranan penting dalam penentuan jatuhnya awal bulan. Teori hisab awal bulan yang ditawarkan Saadoe'ddin Djambek memberikan pondasi pemikiran yang relatif baru untuk waktu itu tentang hisab awal bulan karena disimpulkan dari pemahaman yang terpadu antara ahli hisab dengan ahli astronomi. Metode hisab Saadoe'ddin Djambek termasuk metode hisab yang ketelitiannya tidak berbeda jauh dengan metode hisab awal bulan lain seperti sistem Ephemeris. Dengan demikian metode ini tetap layak digunakan walaupun digagas pada tahun 1970-an.

Kata Kunci: Hisab, Awal Bulan Hijriah, Kontemporer, Saadoe'ddin Djambek.

INTRODUCTION

Determining the beginning of the Hijri month has an important position for Muslims, because the implementation of several acts of worship in Islam is linked to the calculation of the Hijri month. Among these acts of worship are the 'Ied prayer, the eclipse prayer, the calculation of the haul of zakat, the beginning and end of the Ramadan fast, the time of the hajj and so on.[1] The calculation of several important days in Islam is also done according to the calculation of the Hijri month.[2]

In general, there are two major schools of thought that are the source of debate in determining the beginning of the Hijri month. The first is the rukyat school, which is a school that is guided by the literal meaning of the Prophet's hadith, that determining the beginning of the Hijri month must be done through rukyat in the field. The second is the hisab school, which is a school that believes that the beginning of the month can be calculated accurately astronomically without using rukyat, which has many obstacles.[3] In Indonesia, the debate between hisab and rukyat is related to two large organizations in Indonesia, namely Muhammadiyah and Nahdlatul Ulama.[4] Until now, differences in determining the start of the Hijri months, especially Ramadhan, Syawal, and Zulhijah, still often occur. The Indonesian Ulema Council has issued a fatwa to be used as a guideline for determining the start of Ramadan, Shawwal and Zulhijah falling on the same day.[5]

The school of hisab is divided into hisab urfi and hisab hakiki. Hisab urfi is a calendar calculation system based on the average orbit of the Moon around the Earth and is determined

[1] Kasim, A. Jusran, Ahmad Abbas, Nurul Adhha, and Iin Mutmainnah. 2024. "Determination of Hijri Calendar in Islamic History and Its Criteria in Southeast Asia". Journal of Al-Tamaddun 19 (1):247-59. https://doi.org/10.22452/JAT.vol19no1.18.

[2] Badan Hisab & Rukyat Depag RI, *Almanak Hisab Rukyat* (Jakarta: Proyek Pembinaan Badan Peradilan Agama Islam, 1981), p. 98. Departemen Agama RI, *Pedoman Perhitungan Awal Bulan Qamariyah dengan Ilmu Ukur Bola* (Jakarta: Bagian Proyek Pembinaan Administrasi Hukum dan Peradilan Agama, 1983), p. 6.

[3] Tono Saksono, *Mengkompromikan Rukyat & Hisab* (Jakarta: Amythas Publicita, 2007), p. 83. More details can be read in Ahmad Izzuddin, *Fiqh Hisab Rukyat di Indonesia: Upaya Penyatuan Mazhab Rukyah dengan Mazhab Hisab* (Yogyakarta: Logung Pustaka, 2003) and Susiknan Azhari, *Penggunaan Sistem Hisab & Rukyat di Indonesia: Studi tentang Interaksi Muhammadiyah dan NU* (Jakarta: Balitbang dan Diklat Departemen Agama RI).

[4] Ridwan and Muhammad Fuad Zain, Religious symbol on determining the beginning and end of Ramadan in Indonesia, *HTS Teologiese Studies/Theological Studies*, 77. 4 (2021). p. 3. https://doi.org/10.4102/hts.v77i4.6397

[5] Ismail Koto (et.al), Islamic Holy Days: The Contention of Rukyatul Hillal and Hisab Hakiki Wujudul Hilal Disputes for Muslims in, *Pharos Journal of Theology*, 105.2. (2024), p. 8. https://doi.org/10.46222/pharosjot.105.210

conventionally. This hisab system began when it was established by Caliph Umar bin Khattab ra. (17 H) as a reference for compiling an eternal Islamic calendar. The hisab urfi system is no different from the Syamsiyah calendar, the number of days in each month is fixed except for certain months in certain years which are one day longer. Therefore, this hisab system cannot be used in determining the beginning of the Hijriah month for carrying out worship such as the beginning and end of Ramadan, because according to this system the age of the months of Sha'ban and Ramadan is fixed, namely 29 days for Sha'ban and 30 days for Ramadan. Included in the category of hisab urfi are The Muslim and Christian Calendars by G.S.R Freeman Grenville, Takwim Istilah Hijrah-Masehi 1401-1500 H/1980-2077 M, by M. Khair, and Almanac Masehi Hijri 1364 H/1945 M - 1429 H/2010 M, by K.H. Salamun Ibrahim.[6] Meanwhile, the true hisab is a system of hisab based on the actual circulation of the Moon and the Earth. According to this system, the age of each month is not fixed and also irregular, but depends on the position of the crescent moon at the beginning of each month. This means that there may be two consecutive months, generally 29 days or 30 days. It may even alternate as according to the hisab urfi.[7]

In Indonesia, true hisab is grouped into three types, namely true hisab taqribi, true hisab tahqiqi, and contemporary true hisab. True hisab taqribi is a hisab that uses data from the Moon and the Sun based on data and tables from Ulugh Bek with a simple calculation process. This hisab system is only done by adding, subtracting, multiplying, and dividing, without using spherical triangle geometry. Included in this group are Sullamun Nayyirain by Muhammad Manshur, Fathurraufil Manan by Abu Hamdan Abd. Jalil, and Risalah Syamsul Hilal by K.H. Noor Ahmad.[8]

The true hisab of tahqiqi has used tables that have been corrected and uses calculations that are relatively more complicated than the first group and uses spherical triangle geometry. Included in this group are Al-Mahtlaus Sa'id fi Hisabil Kawakib Ala Rusydil Jadid by Sheikh Husain Zaid Al-Misra, Al-Manahijul Hamidiyah by Sheikh Abdul Hamid Mursy Ghaisul Falaky As-Syafi'i, Al-Khulashatul Wafiyah by K.H. Zuber Umar Al-Jailani, Badi'atul Mitsal by K.H. Muhammad Ma'shum bin Ali, Hisab Hakiki by K.H. Muhammad Wardan, and Nurul Anwar by K.H. Noor Ahmad. [9]

Contemporary true hisab has used tables and the latest data that has been corrected, and uses long calculations and uses formulas for spherical triangle geometry. Included in this group are New Comb by K.H. Bidron Hadi, The Astronomical Almanac published annually by the Nautical Almanac Office of the United States Naval Observatory Washington, with the Majesty's Nautical Almanac Office of the Royal Greenwich Observatory Cambridge London, Astronomical Tables of Sun, Moon, and Planets by Jean Meeus, Islamic Calendar by Muhammad Ilyas, Ephemeris Hisab and Rukyat by the Indonesian Department of Religion, Nautical Almanac issued by the TNI-AL Hydro Oceanographic Service Jakarta, and published annually by Her Majesty's Nautical Almanac Office, Royal Green¬wich Observatory, Cambridge, London. This Nautical Almanac system was first developed in Indonesia by

[6] Susiknan Azhari, "Hisab Hakiki Model Muhammad Wardan: Penelusuran Awal" in Choirul Fuad Yusuf dan Bashori A. Hakim (ed.), *Hisab Rukyat dan Perbedaannya* (Jakarta: Balitbang Agama and Diklat Keagamaan Departemen Agama RI, 2004), p. 29-30.

[7] Susiknan Azhari, "Hisab Hakiki Model Muhammad Wardan", p. 31.

[8] Sriyatin Shadiq, "Perkembangan Hisab Rukyat dan Penetapan Awal Bulan Qamariyah" in Muammal Hamidy (ed.), *Menuju Kesatuan Hari Raya* (Surabaya: PT Bina Ilmu, 1995), p. 65-66. Ahmad Izzuddin, *Ilmu Falak Praktis: Metode Hisab-Rukyat Praktis dan Solusi Permasalahannya* (Semarang: Pustaka Rizki Putera, 2012), p. 172-173. Muhyiddin Khazin, *Ilmu Falak dalam Teori dan Praktik* (Yogyakarta: Buana Pustaka, 2004), p. 28-37.

[9] Sriyatin Shadiq, "Perkembangan Hisab Rukyat", p. 67.

Saadoe'ddin Djambek, the first Head of the Hisab Rukyat Agency of the Indonesian Department of Religion.[10]
At that time, not many Islamic scholars paid attention and conducted rukyat hisab studies, even though the discourse on the Hijri calendar or Islamic calendar had long been known to the Indonesian Muslim community. Saadoe'ddin Djambek was one of the people who renewed thinking in the field of hisab (mujaddid al-hisab). One of the thoughts initiated by Saadoe'ddin Djambek was the renewal of the hisab of the beginning of the Hijri month. His thoughts have been written down by several people, but are still global in nature.[11] This article will discuss the hisab of the beginning of the Hijri month in the thoughts of Saadoe'ddin Djambek more specifically on theory and practice.

RESEARCH METHODS

This type of research is library research. Library research is a type of qualitative research whose location or place of research is conducted in libraries, documents, archives and the like.[12] Literature research produces conclusions through content analysis.[13] The library that is the source in this research is a document in the form of books and writings of Saadoe'ddin Djambek, and other writings related to Saadoe'ddin Djambek's hisab thinking. Data sources in qualitative research include words, documents, and others.[14] The data sources in this study are primary data sources and secondary data sources. Primary data sources are books or writings. Secondary sources are books or writings that discuss the thoughts of Saadoe'ddin Djambek. This study uses a documentation method, namely looking for data on things in the form of notes, transcripts, books, biographies, regulations, photos, and so on that are related to the thoughts of Saadoe'ddin Djambek.[15]

ANALYSIS AND DISCUSSION

The Profile About Saadoe'ddin Djambek

Saadoe'ddin Djambek's full name is H. Saadoe'ddin Djambek alias Datuk Sampono Radjo. He was born in Bukittinggi on 29 Rabiul Awal 1329 H, coinciding with March 24, 1911 AD at a time when the Minang region was experiencing a revival upheaval called the Young People. This movement was different from the previous revival movements, such as the Paderi movement (1803-1838), which emphasized the spirit of militarization. The youth movement was more of a renewal of thought, marked by the emergence of various publication media, schools, and organizations that were managed in a modern way. This youth movement also inspired the establishment of the Thawalib School educational institution, an educational institution that was managed in a modern way, both in terms of its management and its curriculum.[16]

Saadoe'ddin Djambek was born into a large, educated family, respected and revered by the wider community. Saadoe'ddin Djambek's father was Sheikh Muhammad Djamil Djambek, who was known as Sheikh Djambek. He was born in 1860 as the son of Muhammad Saleh Datuk Maleka. Sheikh Djambek was known as a scholar who was an expert in astronomy, so he

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[10]Sriyatin Shadiq, “Perkembangan Hisab Rukyat”, p. 67-68.

[11] Susiknan Azhari, Saadoe’din Djambek dan Pekikirannya tentang Hisab, *Al-Jami’ah: Journal of Islamic Studies,* 61 (1998). https://doi.org/10.14421/ajis.1998.3661.159-180.

[12] Andi Prastowo, *Metode Penelitian Kualitatif dalam Perspektif Rancangan Penelitian* (Yogyakarta: Ar-Ruzz Media, 2011), p. 190.

[13] Lexy J. Moleong, *Metodologi Penelitian Kualitatif* (Bandung: Remaja Rosdakarya, 2001), p. 163-165.

[14]Lexy J. Moleong, *Metodologi Penelitian Kualitatif,* p. 112.

[15] Suharsimi Arikunto, *Prosedur Penelitian Suatu Pendekatan Praktek* (Jakarta: PT Rineka Cipta, 2010), p. 274. Sugiyono, *Metode Penelitian Kuantitatif Kualitatif dan R&D* (Bandung: Alfabeta, 2009), p. 240.

[16] Susiknan Azhari, *Pembaharuan Pemikiran Hisab*, p. 47-48.

was given the title al-falaki.[17] Together with Shaykh Thahir Djalaluddin Azhari and H. Abdullah Ahmad, Shaikh Djambek is one of the astronomical experts who spread the use of hisab in preparing prayer time schedules, determining the start of Ramadan and Shawwal.[18]

Saadoe'ddin Djambek was nicknamed mujaddid al-hisab (reformer of reckoning thought). He began studying astronomy through his own father, studying the book Pati Kiraan by Shaikh Thahir Jalaluddin, Almanac Jamiliah by Syaikh Jambek, Hisab Hakiki by Ahmad Badawi, and others. Since the age of 18, Saadoe'ddin has been interested in astronomy.[19]

Saadoe'ddin Djambek's first formal education was obtained at HIS (Hollands Inlandsche School) until he finished in 1924. Then he continued his education at a teacher training school, HIK (Hollands Inlandsche Kweekschool). After graduating from HIK in 1927, he continued his education at Hogere Kweekschool (HKS), a higher teacher training school in Bandung, West Java, and obtained his diploma in 1930. For 4 years (1930-1934) he devoted himself as a teacher at the Gouvernements Schakelschool in Perbaungan, Palembang. After completing his duties as a teacher in Palembang, he tried to continue his education. He applied to be transferred to Jakarta so he could continue his higher education. In Jakarta he worked as a teacher at Gouvernements HIS no. I for a year. In 1935 he had the opportunity to continue his education at the Indische Hoofdakte (education diploma program) in Bandung until he obtained his diploma in 1937. In the same year, he also obtained a diploma in German and French. After completing his education in Bandung, he returned to his duties as a teacher at Gouvernements HIS in Simpang Tiga (East Sumatra). As a teacher, he never stopped developing his career in education. His career continued to improve, from an elementary school teacher to a lecturer at a university and finally to a high-ranking official at the Department of Education and Culture in Jakarta.[20]

Saadoe'ddin Djambek began to be interested in studying the science of hisab in 1929. He learned the science of hisab from Sheikh Taher Jalaluddin, an astronomer from Malaysia, who taught at al-Jami'ah Islamiah Padang in 1939. His meeting with Sheikh Taher Jalaluddin left an impression on him and became the beginning of the formation of his expertise in the field of calculating the calendar. To deepen his knowledge, he then took a Legere Akte Ilmu Pasti course in Yogyakarta in 1941-1942 and took lectures on natural sciences and astronomy at FIPIA (Faculty of Exact Sciences and Natural Sciences) in Bandung in 1954-1955.[21]

His expertise in the field of exact sciences and astronomy was developed through assignments he carried out in several places. In 1955-1956 he became a senior lecturer in exact science courses at PTPG (Teacher Education College) in Batusangkar, West Sumatra. Then he gave lectures on astronomy as a non-permanent lecturer at the Faculty of Sharia, IAIN Sunan Kalijaga Yogyakarta (1959-1961), the Faculty of Tarbiyah, Jakarta Islamic University, and at the Faculty of Ushuluddin, Ibnu Khaldun University in Jakarta (1961). He also became a lecturer in educational sciences at the Faculty of Tarbiyah and a lecturer in astronomy at the Faculty of Sharia, IAIN Syarif Hidayatullah Jakarta (1959-1977).[22]

In addition to being an astronomer, among Saadoe'ddin Djambek's most dominant activities is in the field of education carried out through Muhammadiyah. His activities in turn gained

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[17] Deliar Noer, *Gerakan Moderen Islam di Indonesia 1900-1942,* (Jakarta: LP3ES, 1996), p. 44. M. Bibit Suprapto, *Ensiklopedi Ulama Nusantara: Riwayat Hidup, Karya, dan Sejarah Perjuangan 157 Ulama Nusantara* (Jakarta: Gelegar Media Indonesia, 2009), p. 556-557.

[18] Burhanuddin Daya, *Gerakan Pembaharuan Pemikiran Islam Kasus Sumatera Thawalib* (Yogyakarta: Tiara Wacana, 1995), p. 200.

[19] M. Solahudin, *Ahli Falak dari Pesantren* (Kediri: Nous Pustaka Utama, 2012), p. 18.

[20] Susiknan Azhari, *Ensiklopedi Hisab Rukyat* (Yogyakarta: Pustaka Pelajar, 2008), p. 185-186.

[21] Abdul Azis Dahlan (ed.), *Ensiklopedi Hukum Islam* (Jakarta: PT Ichtiar Baru Van Hoeve, 2006), Vol. I, p. 276.

[22] Abdul Azis Dahlan (ed.), *Ensiklopedi Hukum Islam*, Vol. I, p. 276.

recognition from Muhammadiyah members, so that he was given the trust by the Muhammadiyah Central Leadership to become the chairman of the Muhammadiyah Central Leadership of the Education and Teaching Council in Jakarta for the period 1969-1973. As a figure, Saadoe'ddin Djambek often gained the trust of various parties, both from government and non-government circles. Saadoe'ddin Djambek was once given the trust to become an expert staff of the Minister of Education and Culture. In addition, in 1972 when a meeting of hisab and rukyat experts throughout Indonesia was held, and the formation of the Hisab and Rukyat Agency, Saadoe'ddin Djambek was elected as chairman.[23]

Overseas visits that Saadoe'ddin Djambek has made include the Mathematical Education Conference in India (1958), Comprehensive Schools in India, Thailand, Sweden, Belgium, England, the United States, and Japan (1971), research into the development of hisab and rukyat sciences and social life in the holy land of Mecca, and attending the First World Conference on Muslim Education in Mecca (1977). Saadoe'ddin Djambek died on Tuesday, 11 Zulhijjah 1397 H, coinciding with November 22, 1977 AD in Jakarta. He was buried near the tomb of Prof. Dr. T.M. Hasbi Ash-Shiddieqy.[24]

Saadoe'ddin Djambek's expertise in the science of hisab, astronomy, astronomy, and mathematics is evident from the works he wrote. Among his works are *Waktu dan Djidwal: Penjelasan Populer Mengenai Perdjalanan Bumi, Bulan dan Matahari, Almanak Djamilijah, Arah Qiblat dan Tjara Menghitungnja dengan Djalan Ilmu Ukur Segitiga Bola, Menghisab Awal Waktu Shalat, Perbadingan Tarich: Memuat Djadwal-Djadwal untuk Memindahkan Penanggalan Tarich Hijrijah dan Tarich Djawa serta Sebaliknja, Pedoman Waktu Shalat Sepanjang Masa, Shalat dan Puasa di daerah Kutub,* serta *Hisab Awal Bulan*.[25]

Thoughts on Reckoning at the Beginning of the Month of Saadoe'ddin Djambek

The concept of the "beginning of the month" or "new month" of the Hijri calendar

The calculation of the beginning of the Hijri month is a calculation to determine when the change from the old month to the next new month occurs. According to Saadoe'ddin Djambek, building a concept about the new Hijri month must be done carefully because it not only concerns community life, but more importantly concerns the issue of practicing religious teachings. Mistakes that occur in formulating the concept of the new Hijri month can result in mistakes in implementing religious teachings, such as fasting during Ramadan. That is what makes Saadoe'ddin Djambek careful in building his theory based on an understanding of the Qur'an and Sunnah. These two sources are then approached and understood through the discipline of astronomy, so that they can be understood with reason and can be proven empirically.[26]

According to Saadoe'ddin Djambek, as a result of the Moon's circulation around the Sun, the Earth's position relative to the Moon and Sun changes. This change in position causes the part of the Moon exposed to sunlight that can be seen from Earth to change. Seen from Earth, this change is like a crescent moon which gets bigger every day until it reaches the full moon and then becomes smaller and smaller until finally it is not visible at all.[27] The smallest shape

[23] Susiknan Azhari, *Pembaharuam Pemikiran Hisab*, p. 51-52.

[24] Susiknan Azhari, *Pembaharuam Pemikiran Hisab*, p. 53.

[25] Oman Fathurrohman SW., "Saadoe'ddin Djambek dan Hisab Awal Bulannya" in Choirul Fuad Yusuf dan Bashori A. Hakim (ed.), *Hisab Rukyat dan Perbedaannya* (Jakarta: Balitbang Agama dan Diklat Keagamaan Departemen Agama RI, 2004), p. 95-97. Muhyiddin Khazin, *Kamus Ilmu Falak* (Yogyakarta: Buana Pustaka, 2005), p. 114-115. Susiknan Azhari, *Ensiklopedi Hisab Rukyat*, p. 187.

[26] Oman Fathurrohman SW., "Saadoe'ddin Djambek dan Hisab Awal Bulannya" in Choirul Fuad Yusuf dan Bashori A. Hakim (ed.), *Hisab Rukyat dan Perbedaannya* (Jakarta: Balitbang Agama and Diklat Keagamaan Departemen Agama RI, 2004), p. 98-99.

[27] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 9.

of the Moon is achieved around the time of the conjunction between the Moon and the Sun.[28] Ijtimak occurs when the Sun and Moon are positioned on the same celestial circle. At that time, the longitude of the Moon and the Sun are the same. At that time there is still a distance between the Moon and the Sun which can reach a value of 5o either North or South of the Sun even though at some time the Sun and Moon can overlap. When ijtimak occurs and the Sun and Moon overlap, then at that time a solar eclipse will occur.[29]

In Saadoe'ddin Djambek's thinking, the return of the Moon in its smallest form is used as the standard for the start of a new month. This opinion is based on the word of Allah in the letter Yasin verse 39 which means "And We have determined for the Moon, manzilah-manzilah, so that it returns as the form of an old sheath". However, according to Saadoe'ddin Djambek, ijtimak as the time when the Moon is experiencing its smallest form is difficult to observe. For that, that the Moon returns to the form of urjun al-qadim as mentioned above becomes difficult to determine. To solve this problem, Saadoe'ddin Djambek uses the next verse, namely verse 40, which means "it is not fitting for the Sun to chase the Moon". This verse strengthens astronomical knowledge that the monthly journey of the Moon and the annual journey of the Sun are in the same direction, namely from West to East. The Moon travels every day 13o and the Sun 1o so that the Moon is faster and it is impossible for the Sun to catch up, let alone precede it. From this verse, Saadoe'ddin Djambek concluded that a new month begins when the Moon is positioned to the East of the Sun.[30]

The apparent shapes of the Moon are characterized by two elements. First, the part of the Moon's surface that is visible from Earth is illuminated by the Sun. Second, its place is in the sky. The new moon is visible as a thin crescent and sets after sunset. The full moon looks full and rises when the sun sets. The old moon looks like a crescent that rises at dawn before the Sun. Verse 39 above describes the influence of sunlight on the new moon (urjun al-qadim). In the first part, verse 40 explains the position of the Moon which precedes the Sun. In this way, two elements regarding the properties of the new moon are fulfilled astronomically.[31]

Then Saadoe'ddin Djambek explained that the standard that is used to measure the Moon is already to the east of the Sun is the horizon. This conclusion was taken by Saadoe'ddin Djambek from understanding the wording of verse 40 of the Yasin letter further which means "and the night cannot precede the day". According to him, what is meant by the verse is the evening situation when night replaces day. The transition from day to night is marked by the setting of the Sun and what is meant by the Sun setting is when it is below the horizon. This is an indication that the horizon is the boundary to determine whether the Moon is already to the East or still to the West of the Sun.[32]

Furthermore, Saadoe'ddin Djambek said that what must be done in calculating the first date of a new month is by placing the Sun in a setting position and then determining the position of the Moon. If the Moon is above the horizon, it indicates that the Moon is already to the East of the horizon and at the same time to the East of the Sun. At that time the new moon already exists or the crescent moon has appeared. Conversely, if the Moon is below the horizon, it means that the Moon is still to the West of the horizon and at the same time to the West of the Sun, so that night is still an old month. Thus, according to Saadoe'ddin Djambek, what must actually be done to determine the new month is not to determine how high the Moon is above the horizon when the Sun sets on the 29th of the Hijri month, but to calculate whether

[28] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 10.
[29] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p 6.
[30] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 10-11.
[31] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 12.
[32] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 13.

the Moon is already to the East of the Sun or not at the time the Sun sets. The result of the calculation is the requirement for someone to be considered a “martyr” as a requirement for fasting as stated in the letter of al-Baqarah verse 185 which means “whoever among you knows that the month (Ramadan) has already appeared, let him fast”. Then according to Saadoe'ddin Djambek, the technique for knowing the condition of the moon as explained above can be done by rukyat or by hisab.[33]

Beginning of the Day Concept

The concept of when the day begins is never explicitly conveyed by Saadoe’ddin Djambek in his book. The concept of the beginning of the day according to Saadoe’ddin Djambek can be understood when he explains the concept of the new moon. As previously stated, the entry of the new moon is determined by calculating whether the Moon is already to the East of the Sun or not at sunset.[34]

The change of the new month also means the change of day. Because the change of the new month begins to be counted when the Sun sets or Maghrib, then the change of day as well as the beginning of the day is also counted at sunset or Maghrib. This is certainly different from the beginning of the day in the Gregorian calendar which begins when the Sun culminates below midnight, namely at 24 o'clock or 00 o'clock.[35]

Concept of Hijri Month Date Boundary Lines

Before explaining the date line, Saadoe'ddin Djambek first explained about the date line. The date line is the boundary between places that have experienced the fall of the 1st of the Hijri month with places that have not experienced the fall of the 1st of the Hijri month. In that place, the Moon and the Sun set at the same time. If the place is likened to a city B, then it means that all places that are to the East of B, the Moon sets before the Sun and for all places that are to the West of B, the Moon sets later than the Sun.[36]

If all the places on the Earth's surface that experience the same thing as explained above are connected with a curved line that is not broken, then a curved line will be formed. This curved line is called the date line.[37] According to Saadoe'ddin Djambek, the date lines can be drawn for places all over the world, so that one can see in which parts of the world the places have entered the new month and in which parts of the world the places have not yet entered the new month.[38]

However, sometimes the date line falls in the middle of a city, or an island, or a government unit area, such as a district, province, or even a country. In such circumstances, it is impossible for a city to experience a different new moon because it is separated by the date line. To achieve a unified calendar for a place or island, Saadoe'ddin Djambek said that the date line must be turned to the West. By turning the date line to the West, places to the West that might have seen the new moon are considered not to have seen the Moon and have not experienced the new moon. On the other hand, areas to the east of the line that are completely unlikely to see the Moon are not considered to have seen it.[39]

Practical Reckoning Thinking

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[33] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 16.

[34] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 15.

[35] Susiknan Azhari, *Kalender Islam: Ke Arah Integrasi Muhammadiyah-NU* (Yogyakarta: Museum Astronomi Islam, 2012), h. 3. Muh. Nashirudin, *Kalender Hijriah Universal: Kajian atas Sistem dan Prospeknya di Indonesia* (Samarang: El-Wafa, 2013), p. 76. M. Ma’rifat Iman, *Kalender Pemersatu Dunia Islam* (Jakarta: Gaung Persada Press, 2010), p. 138.

[36] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 35.

[37] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 37.

[38] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 38.

[39] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 40.

The calculation of the beginning of the month developed by Saadoe'ddin Djambek is a combination of conventional calculations and modern astronomy. In the calculation of the beginning of the Hijri month, Saadoe'ddin Djambek presents a theory that is different from previous theories. This theory is known as the theory of ijtimak and mar'i horizon. In this theory, the beginning of the Hijri month begins when the sun sets after ijtimak and at that time the crescent moon is above the mar'i horizon (visible horizon). What is meant by the mar'i horizon is a flat plane that is the limit of the observer's eye view. The higher the observer's eyes are above the Earth's surface, the lower the mar'i horizon is. This mar'i horizon circle appears as the meeting point between the wall of the celestial sphere and the Earth's surface. Therefore, the mar'i horizon is often also called the skyline. The difference between the mar'i horizon and the true horizon lies in the lowness of the horizon (dip). The position or position of the Moon on the horizon according to this theory is the position or upper edge of the Moon on the mar'i horizon. So according to this theory, the beginning of the Hijri month begins at sunset after the ijtimak occurs and at that time the upper edge of the Moon's disk is already above the mar'i horizon.[40]

The concept of the beginning of the month calculation adopted by Saadoe'ddin Djambek uses the science of spherical triangle measurement or trigonometry. The formulas used in the calculation are divided into two types, namely calculations using logarithms and calculations using trigonometry theory with the help of a calculator. This can be seen in the explanation when giving an example of the beginning of the month calculation.[41]

Saadoe'ddin Djambek used data taken from the Nautical Almanac in the process of calculating the beginning of the month. This can be seen in the Nautical Almanac data that he displayed in calculating the position of the crescent moon at the end of Sha'ban 1394 H, coinciding with September 16, 1974 as the determinant of the beginning of the month of Ramadan 1394 H.[42]

The data used in the early month calculation are generally made by assuming that the celestial bodies are seen from the center of the Earth. So the data are geocentric. For example, if at a certain time the declination of a celestial body is 3° 27' North, it means that seen from the center of the Earth its position is 3° 27' north of the celestial equator. The benefit of using this method is that the data can be used for the entire world. To solve problems in astronomy, the calculation uses a celestial sphere triangle, which has its center point at the center of the Earth. Because all the data used are geocentric, the calculation results are also geocentric. This means that if the calculation shows that the moon is positioned so many degrees above the horizon, then that is according to the situation if the observer is imagined to be positioned at the center of the Earth. The geocentric height must be made the height as seen from the Earth's surface by making it topocentric, namely by making a correction called parallax.[43]

The steps for calculating the beginning of the month of Saadoe'ddin Djambek are as follows:

Determining the sunset time. Calculating the sunset time is preceded by calculating the angle of the Sun's time. Calculating the angle of the Sun's time can use the following two formulas.[44]

$$\sin\frac{1}{2}\,t = \sqrt{\frac{\cos(s+p)\,\cos(s+d)}{\cos p\,\cos d}}$$

[40] Susiknan Azhari, *Pembaharuan Pemikiran Hisab*, p. 70-71.
[41] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 25-31.
[42] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 27.
[43] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 20.
[44] Saadoe'ddin Djambek, *Hisab Awal Bulan*, p. 25.

2s = $270^o – (p+d+h)$ (1)
cos t = tan p tan d + sec p sec d sin h (2)

With (p) being the latitude of the place, (d) being the declination of the Sun obtained from the Nautical Almanac data, and (h) being the height of the Sun. Then after obtaining the value of the Sun's time angle, the next step is to calculate the sunset time. The data required are the time rectifier or equation of time, meridian pass, and longitude of the place.

The next step is to determine the Moon data needed to calculate the height of the crescent moon such as the Greenwich Hour Angle (GHA) of the Moon and the Moon's declination. These data are used to determine the Moon's time angle which is then used to calculate the height of the Moon or crescent moon.[45]

Then calculate the height of the Moon using three types of data, namely p, t and d of the Moon. The formula used is:[46]

tan q = cotan d cos t

$$\sin h = \frac{\sin d \sin p \ (p+q)}{\cos q}$$

The next step is to make corrections to the height of the Moon with parallax correction, refraction, s.g.t (half the diameter) or semi diameter, and horizon lowness or dip. As for obtaining the parallax correction value using the formula Par = HP x cos h, the refraction value is obtained in appendix II of the early month calculation book, the semi diameter is taken from the Nautical Almanac data and the horizon lowness value is the same as the Sun. Height see = h – par + ref + s.g.t + horizon lowness.[47]

The last is to calculate the azimuth of the Moon and the Sun. The results of the azimuth calculation carried out by Saadoe'ddin Djambek show the number of degrees and minutes on the horizon circle calculated from the North or South point. The calculation formula is as follows: [48]

$$\text{cotan A} = \frac{cotan\, t \cos(p+q)}{\sin q}$$

Saadoe’ddin Djambek Month Beginning Calculation Application

The application of the initial calculation of the month of Saadoe’ddin Djambek begins by calculating the sunset time, determining the data of the Moon, calculating the height of the Moon, and corrections to it, then calculating the azimuth of the Sun and Moon. The following is the application of the calculation of the initial calculation of the month of Sa’adoedin Djambek by taking the example of the calculation of the end of Sha’ban 1438 H coinciding with May 26, 2017 as the determinant of the beginning of Ramadan 1438 H with the location of the Roof of the Aston Purwokerto Hotel (p = 7º 25’ LS and 109º 15’ BT, h = 139 m). As with the calculation process in the book of Saadoe’ddin Djambek, the author performs the calculation by inputting data from the Nautical Almanac data. The following is the Nautical Almanac data on May 26, 2017.

45 Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 28.
46 Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 28-29.
47 Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 29.
48 Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 30.

GMT	SUN		MOON				
	GHA	Dec	GHA	v	Dec	d	HP
08	300° 44'.4	10'.5	292° 17'.0	3'.9	29'.6	5'.5	
09	315° 44'.4	10'.9	306° 39'.9	3'.8	35'.1	5'.4	
10	330° 44'.3	11'.4	321° 02'.7	3'.9	40'.5	5'.3	
11	345° 44'.2	11'.8	335° 25'.6	3'.7	45'.8	5'.1	
12	0° 44'.2	21° 12'.2 N	349° 48'.3	3'.8	17° 50'.9 N	5'.0	61'.4

Source: Navsoft's 2017 Nautical Almanac on May 26, 2017

The calculation steps after preparing the Sun and Moon data are a) calculating the sunset time, b) Moon height data, c) and correcting the Moon data.

Calculating the sunset time. To calculate the sunset time, it is necessary to calculate the time angle. In astronomy it is called the hour angle and is symbolized by the letter t. To calculate the sunset time, several calculations are carried out, namely calculating the sun's time angle and calculating the sunset time, namely in the following way:

With logarithms:

$$\sin\frac{1}{2}\,t = \sqrt{\frac{\cos(s+p)\,\cos(s+d)}{\cos p\,\cos d}}$$

2s = 270° – (p+d+h)

Data:

p = - 7° 25'

d = 21° 11.8'

h = -1° 12'

p+d+h = 12° 34' 48"

2s = 270 ° - 12° 34' 48" = 257° 25' 12"

s = 128° 43'

Calculations with logarithms

s	=	128° 43'
p	=	-7° 25'
d	=	21° 11.8'
s + p	=	121° 18'
s + d	=	149° 55'
log cos 121° 18'	=	9.7156 – 10
log cos 149° 55'	=	9.9372 –10 +
	=	9.6528 – 10
log cos -7° 25'	=	9.9964 – 10
log cos 21° 11.8'	=	9.9696 – 10 +
	=	9.9660 – 10
	=	9.6528 – 10
	=	9.9660 – 10 -
2 log sin ½ t	=	9.6868 – 10
log sin ½ t	=	9.8434 – 10
½ t	=	44° 12' 29.73"
t	=	88° 24' 59.46" or fulfilled 88° 25'

If you use a calculator:

cos t = tan p tan d + sec p sec d sin h

cos t = tan -7° 25’ tan 21° 11.8’ + sec -7° 25’ sec 21° 11.8’ sin - 1 12’= 88° 24’ 18.8’’ (or fulfilled 88° 24’).

The results of calculations with logarithms and calculators are different. Calculations with logarithms will produce 88° 24’ 59.46” and calculations with a calculator 88° 24’ 18.8’’. Before calculating the sunset time, the Nautical Almanac data is required as follows:

	SUN			MOON		
	Eqn. of Time		Mer.	Mer. Pass.		
Day	00h	12h	Pass.	Upper	Lower	Age/ Vis
25	3 06	3 03	11:57	11:41	24:12	29d 0%
26	3 00	2 57	11:57	12:43	00:12	1d 1%
27	2 53	2 50	11:57	13:45	01:14	2d 4%

Source: Navsoft’s 2017 Nautical Almanac on May 26, 2017

From the data above, it is known that the Equation of time for May 26 at 00h is 3m 00s and at 12h is 2m 57s. In 12 hours there is a difference of 3d, meaning that per hour the difference is 0.25d. So the Equation of time at 11 GMT is 2m 57s + 00m 0.25s = 2m 57.25s. Then calculate the sunset time GMT, namely:

The Time of Zuhur = $11^h\ 57^m\ 03^s$

t of the Sun (88° 24’ 18.8’’/15) = $\underline{05^h\ 53^m\ 37^s}$ +

= $17^h\ 50^m\ 40^s$

Longitude of the Place (109° 15’/15) = $07^h\ 17^m\ 00^s$ -

The Sun Set = $10^h\ 33^m\ 40^s$ GMT /$17^h\ 33^m\ 40^s$ WIB

Calculating the height of the crescent moon. The next step is to find the value of the time angle (t) and the declination of the Moon (d) at sunset, which is at 10h 33m 40d GMT. By using the list in appendix III of the early month hisab book, there needs to be a correction for the GHA correction data (v) and the change in declination (d) from the data below.

GMT	SUN		MOON				
	GHA	Dec	GHA	v	Dec	d	HP
08	300° 44'.4	10'.5	292° 17'.0	3'.9	29'.6	5'.5	
09	315° 44'.4	10'.9	306° 39'.9	3'.8	35'.1	5'.4	
10	330° 44'.3	11'.4	321° 02'.7	3'.9	40'.5	5'.3	
11	345° 44'.2	11'.8	335° 25'.6	3'.7	45'.8	5'.1	
12	0° 44'.2	21° 12'.2 N	349° 48'.3	3'.8	17° 50'.9 N	5'.0	61'.4

Remaining minutes and seconds at sunset time $10^h\ 33^m\ 40^s$ GMT is $33^m\ 40^s$ menjadi 0.5611 hours. The value of (v) is 0.5611 x (14° 19’[49] + 0° 3.9’) = 0.5611 x 14° 22.9’ = 8° 4’ 10.39”. The value of (d) is 0.5611 x 5.3’ = 0° 2’ 58.7’

		T	d
GHA at 10 o'clock GMT	=	321° 02’ 42.00”	17° 40’ 30.00”
v and d for $33^m\ 40^d$	=	8° 04’ 10.39”	0° 02’ 58.70” +
The Longitude of Place	=	109° 15’ 00.00” +	17° 43’ 28.70”

[49] Values that need to be added to the existing GHA(v) corrections for the use of the new Nautical Almanac data. See Abd. Rachim, *Ilmu Falak* (Yogyakarta: Liberty, 1983), p. 61-62.

78° 21' 52.39"

Through three data, namely p, t, and d of the month, the calculation of the height of the Moon can be done using the formula:

$$\sin h = \frac{\sin d \sin p\ (p+q)}{\cos q}$$

p = -7° 25', d = 17° 43' 28.7'', t = 78° 21' 52.39" dan q = sudut bantu

Solution with logarithms:

log cotg 17° 43' 28.7'' (d)	= 10.4956 – 10
log cos 78° 21' 52.39" (t)	= 9.3046 – 10 +
log tg q	= 9.8002 – 10[50]
q	= 32° 15' 43.51"
p	= - 7° 25' +
q+p	= 24° 50' 43.51"
log sin 17° 43' 28.7'' (d)	= 9.4833 - 10
log sin 24° 50' 43.51" (q+p)	= 9.6235 – 10 +
	= 9.1068 – 10
log cos 32° 15' 43.51" (q)	= 9.9272 – 10 -
log sin h	= 9.1796 – 10
h (moon height)	= 8° 41' 50.81" fulfilled 8° 42'

If calculated with a calculator using the formula below:

Sin h = sin p sin d + cos p cos d cos t

Sin h = sin - 7° 25' sin 17° 43' 28.7" + cos - 7° 25' cos 17° 43' 28.7" cos 78° 21' 52.39" = 8° 41' 48.18" (dibulatkan 8° 42')

c. Calculating the correction to the height of the Moon (h = 8° 41' 48.18")

h	=	8° 41' 48.18"		
Parallax	=	1° 00' 41.64"	-	The data from almanak nautika
	=	7° 41' 6.54"		
Refraction	=	0° 06' 42.00"	+	Appendix IV book hisab awal bulan
	=	7° 47' 48.54"		
Semidiameter	=	0° 16' 42.0"	+	The data from almanak nautika
	=	8° 4' 30.54"		
The lowliness of the horizon	=	00° 21' 00"	+	
Height from sight	=	8° 25' 30.54"		

Calculating the azimuth of the Sun and Moon

The next step is to calculate the azimuth of the Sun and the azimuth of the Moon. The azimuth to be calculated is the angle calculated on the horizon circle, calculated from the North point. Formula for calculating azimuth:

$$\text{cotan A} = \frac{cotan\ t \cos(p+q)}{\sin q}$$

[50] How to change the logarithm result into degrees with a calculator is to press shift tan shift log. For example changing 9.8002 – 10 to degrees is press shift tan shift log (9.8002 – 10) = 32.26208645= 32° 15' 43.51". and so on, just adjust the function value. see Anisah Budiwati, "Telaah Pemikiran Hisab Saadoe'ddin Djambek (Sebuah Upaya Menuju Unifikasi Kalender Indonesia)" in *Jurnal Bimas Islam,* Vol. 6 No. 1 Year 2013, 120.

q is the auxiliary angle (32° 15’ 43.51”), which has been used in the previous section. The magnitude of the Moon's time angle is known, then the magnitude of the Sun's direction will be determined:

log cotg 21° 11.8’ (dM)	=	10.4113 – 10	
log cos 88° 24’ 18.8’’ (tM)	=	<u>8.4459 – 10</u>	+
log tg q	=	8.8572 – 10	
q	=	4° 7’ 0.98”	

Calculations with logarithms:

Sun			Month		
t	=	88° 24’ 18.8”	t	=	78° 21’ 52.39”
p	=	-7° 25”	p	=	-7° 25”
q	=	4° 7’ 0.98”	q	=	32° 15’ 43.51”
p+q	=	3° 17’ 59.02”	p+q	=	24° 50’ 43.51”
log cotg t	=	8.4461 – 10	log cotg t	=	9.3136 – 10
log cos(p+q)	=	<u>9.9993 – 10</u> +	log cos(p+q)	=	<u>9.9578 – 10</u> +
	=	8.4454 – 10 -	-	=	9.2714 – 10
log sin q	=	<u>8.8560 – 10</u> –	log sin q	=	<u>9.7274 – 10</u> –
log cotg A	=	9.5894 – 10	log cotg A	=	9.5440 – 10
cotg A	=	0.38850803	cotg A	=	0.349945167
Azimuth	=	68° 46’ 6.43” (U-B) or 21° 13’ 53.57” (B-U)	Azimuth	=	70° 42’ 45.91” (U-B) or 19° 17’ 14.09” (B-U)

Calculation of the Sun's azimuth with a calculator:
Cotg A = -sin p x cotg t + cos p x tg d x cosec t
Cotg A = -sin -7° 25’ x cotg 88° 24’ 18.8” + cos -7 ° 25’ x tg 21° 11’ 48” x cosec 88° 24’ 18.8” = 68° 46’ 42.66” (U-B)
Calculation of the azimuth of the Moon with a calculator:
Cotg A = -sin p x cotg t + cos p x tg d x cosec t
Cotg A = -sin -7° 25’ x cotg 78° 21’ 52.39”+ cos -7° 25’ x tg 17° 43’ 28.7” x cosec 78° 21’ 52.39” = 70° 42’ 4.5” (U-B)
In the initial calculation of the month of Saadoe’ddin Djambek, the azimuth values of the Sun and Moon are calculated from the North point to the South point (US) and do not use the terms UB (North West) and SB (South West) as in the calculation of the ephemeris system in general. If the value of A < 90°, then the azimuth of the celestial body is calculated from the North, while if A > 90°, then the azimuth of the celestial body is calculated from the South.[51]

Analysis of Saadoe'ddin Djambek's Thoughts

According to the author, Saadoe’ddin Djambek’s early month calculation thoughts can be classified into thoughts related to early month calculation theories and thoughts related to practical calculations. His theoretical thoughts are such as the concept of the new moon, the concept of the day, and the concept of the date line. While his practical calculation thoughts are the use of Nautical Almanac data in calculating the beginning of the month.[52] Nautical

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[51] Saadoe’ddin Djambek, *Hisab Awal Bulan*, p. 31.

[52] This can be concluded from what is explained in Saadoe'ddin Djambek's book entitled *Hisab Awal Bulan.*

Almanac is astronomical data issued by the cooperation of the Royal Greenwich Observatory (England) with the United States Naval Observatory (America). This Nautical Almanac contains a list of Declination, Equation of Time (time aligner), the time of sunrise and sunset of the Sun and Moon, and so on related to data on celestial objects.[53] To get the Nautical Almanac data in book form, you can only order or buy it from the TNI-AL. This is because the Nautical Almanac is not freely sold in bookstores. But the Nautical Almanac data in softcopy form can be downloaded via the internet.

In explaining the concept of the new moon as a sign of the entry of the month into the Hijri calendar, Saadeo'ddin Djambek uses the standard position of the Moon whether it is to the East of the Sun or not. This is of course after the ijtimak occurs. If the Moon is to the East of the Sun, it means that the new moon has arrived or the crescent moon has appeared, and vice versa. What was conveyed by Saadoe'ddin Djambek was the result of his understanding of the verses of the Qur'an, Yasin letter, verses 39 and 40 and Al-Baqarah letter, verse 185, which were combined with an understanding of several hadiths of the Prophet SAW.

Saadeo'ddin Djambek's thoughts show the integration between understanding verses or hadiths with astronomical science or a combination of the thoughts of hisab experts and astronomers as mentioned by Susiknan.[54] Saadoe'ddin Djambek also said that the problem of calculating the beginning of the month is not calculating how high the crescent moon is when the sun sets, but calculating whether at the time the sun sets, the crescent moon is already to the east or not. In other words, whether the crescent moon is above the horizon or not. This is what Oman Fathurrahman later called Saadeo'ddin Djambek as a follower of hisab wujudul hilal.[55] This is the method of determining the beginning of the month which is used as a guideline by Muhammadiyah.[56]

The next concept is the beginning of the day according to Saadeo'ddin Djambek. The day according to Saadeo'ddin Djambek begins from sunset or Maghrib. This is understood from Saadoe'ddin Djambek's concept of the beginning of the month whose standard is the position of the crescent moon at Maghrib time. The concept of the beginning of the day in Saadeo'ddin Djambek's thinking which begins from sunset is the same as the opinion of the majority of fuqaha who state that the beginning of the day is when the sun sets. That is why the majority of fuqaha say that zakat fitrah is paid starting from Maghrib night on the 1st of Shawwal or Eid al-Fitr night.[57] The concept of the beginning of the day is certainly different from the concept of the beginning of the day in the Gregorian calendar which begins at midnight at 24:00 or 00:00. Although recently the idea emerged that there needs to be a change in the beginning of the day in the Hijri calendar so that it is the same as the beginning of the day in the Gregorian calendar which was conveyed by a hisab thinker, namely Jamaluddin Abdurraziq as the initiator of the unified Hijri calendar.[58]

Saadeo'ddin Djambek's thoughts on date lines are intended to make it easier for people to determine which areas or places have entered the new month and which places have not yet entered the new month. The concept of this date line is similar to the date line initiated by

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[53] Abd. Rachim, *Ilmu Falak*, p. 60-61.

[54] Susiknan Azhari, *Pembaharuan Pemikiran Hisab*, p. 58.

[55] Oman Fathurrohman SW., "Saadoe'ddin Djambek dan Hisab Awal Bulannya" dalam Choirul Fuad Yusuf dan Bashori A. Hakim (ed.), *Hisab Rukyat dan Perbedaannya,* p. 120.

[56] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, *Pedoman Hisab Muhammadiyah* (Yogyakarta: Majelis Tarjih dan Tajdid PP Muhammadiyah, 2009), p. 78.

[57] Muhammad Jawad Mughniyah, *Fiqh Lima Mazhab*, trans. Masykur AB, et.al. (Jakarta: Lentera, 2011), p. 197.

[58] Syamsul Anwar, *Hari Raya dan Problematika Hisab Rukyat* (Yogyakarta: Suara Muhammadiyah, 2008), p. 137.

Muhammad Ilyas, namely the International Lunar Date Line or ILDL. However, the context of Saadeo'ddin Djambek's thoughts is not as detailed as the concept of the date line initiated by Ilyas because the date line initiated by Saadeo'ddin Djambek is only limited to knowing which areas have entered the new month and which areas have not yet entered the new month. Meanwhile, the concept of the date line initiated by Ilyas is a basic concept in order to realize a unificatory Hijri calendar. This date line changes according to whether or not the crescent moon is visible from a certain place on Earth.[59]

In relation to Saadoe'ddin Djambek's thoughts on the practical calculation of the beginning of the month, it can be said that Saadeo'ddin Djambek's practical hisab is classified as a contemporary true hisab because it uses contemporary data, namely the Nautical Almanac. The calculation technique is offered in two types, namely using logarithmic calculations and using trigonometric formulas that are operated using a calculator. Of course there are differences in the data from calculations carried out using logarithms and data from calculations using a calculator. The difference data can be seen, for example, in the results of calculating the time of sunset, data on the height of the crescent moon, and data on the azimuth of the crescent moon and the Sun. If the calculation is carried out using logarithms, it takes a long time and the results are less valid. It is different if the calculation is carried out using a calculator, besides being practical, the results obtained are more valid.

According to the author, if the results of the initial month calculation using Saadoe'ddin Djambek's method are compared with the results of the ephemeris method, there is not much difference. For example, in the calculation results of Saadeo’ddin Djambek’s initial month calculation method for the position of the crescent moon at the end of Sha’ban 1438 H or May 26, 2017 M with the location of the Aston Purwokerto Hotel roof, where the sunset time is 17h 33m 40d WIB, the height of the true crescent moon is 8º 41’ 48.18”, the height of the mar’i crescent moon is 8º 25’ 30.54”, the azimuth of the Sun is 68º 46’ 42.66” (N-W) or 21º 13’ 17.34” (W-U), and the azimuth of the crescent moon is 70º 42’ 4.5” (N-W) or 19º 17’ 55.5” (W-U). The results obtained from the initial month calculation for the same location and time as the Ephemeris data obtained for the sunset time are 17h 33m 38.33s WIB, the height of the true crescent moon is 8º 41’ 43.03”, the height of the mar’i crescent moon is 8º 24’ 40.65”, the azimuth of the Sun is 21º 13’ 12.48” (W-N), and the azimuth of the crescent moon is 19º 17’ 52.38” (W-N). From this comparison, it can be seen that there is only a small difference with other contemporary data, namely only in seconds. Thus, the Saadoe’ddin Djambek initial month calculation model is classified as having high accuracy like other contemporary initial month calculation methods.

CONCLUSION

Saadoe’ddin Djambek’s thoughts on the calculation of the beginning of the Hijri month can be categorized as contemporary calculations because they use contemporary data and calculation processes, namely Nautical Almanac data and trigonometric functions. The theory of calculating the beginning of the month initiated by Saadoe’ddin Djambek provides a relatively new foundation for thinking at that time about calculating the beginning of the month because it is concluded from an integrated understanding between calculation experts and astronomers. Saadoe’ddin Djambek’s calculation method is a contemporary calculation method with a level of validity that is almost the same as other calculation methods for the beginning of the month such as the Ephemeris system. It becomes more accurate if Saadoe’ddin Djambek’s calculation

[59] Muhammad Ilyas, *A Modern Guide to Astronomical Calculations of Islamic Calendar, Times & Qibla* (Kuala Lumpur: Berita Publishing Sdn. Bhd, 1984), p. 115.

method is developed with a contemporary algorithm system. To make it easier to use, this calculation method can be made into a more modern application.

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