Journal of Al-Tamaddun, Vol. 19 (1), 2024, 247-259
https://doi.org/10.22452/JAT.vol19no1.18

Determination of Hijri Calendar in Islamic History and Its Criteria in Southeast Asia

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Abstract

It is common for the beginning of Ramadhan and Shawwal to cause differences. In 2022, the *imkān ar-ru'yah* (visual moonsighting) Neo-MABIMS was introduced in Indonesia as an effort to unify the Islamic calendar. However, it is often compared to the *hisab wujudul hilal* (lunar calculation) method. This study aims to project the hilal (new moon) altitude and elongation angle after the implementation of Neo-MABIMS and compare the beginning of the month of Ramadhan and Shawwal between *imkān ar-ru'yah* and *hisab wujudul hilal*. A quantitative method was used to reveal differences between 2023 and 2031. Data was analysed using a comparative approach with the support of the Starry Night Pro Plus 6 and Accurate Hijri Calculator 2.2 applications. The results of this study show that a hilal altitude of 3° with an elongation angle greater than 6.4° was found in three periods for the beginning of Ramadhan (2023, 2029, 2030). Meanwhile, for the beginning of Shawwal, this was found in only two periods (2024 and 2031). In the comparison between *imkān ar-ru'yah* and *hisab wujudul hilal*, there will be differences marking the beginning of the month of Ramadhan in the years 2024, 2025, and 2030. Similarly, the onset of Shawwal will experience distinctions in 2023, 2026, and 2030. As a result, *hisab* (calculations) and *ru'yah* (sighting) adherents will differ on the day of celebration of *Eid al Fitr* to as many as three different dates.

Keywords: Wujudul Hilal, Imkān ar-ru'yah, Neo-MABIMS, Ramadhan, Shawwal

Introduction

Many scholars have studied the determination of the beginning of Islamic months in Asia and Australia.[1] These differences are certain given that differences exist in the methods of determining the new months between using *hisab* and *ru'yah*. The differences in determining the beginning of the Hijri month in the lunar calendar have a significant impact on Islamic activities, such as identifying the beginning of the fast in the month of Ramadan and celebrating *Eid al Fitr*. This debate revolves around the differences in the Islamic tradition of hilal sightings and has a significant impact on social harmony.[2] The beginning of Ramadan and Shawwal tends to be determined by *fiqh* and technical factors. The *fiqh* factor adheres to the concept of *hisab* or calculation, the concept of *ru'yah* and the problem of time limits,[3] while the technical (astronomical) factor covers various discussions including differences among *hisab* experts (taqribi*, tahqiqi,* and *contemporary hisab*). There are also differences among *ru'yah* experts covering *mathla* (the moon sighting zone) problems[4] and the way the moon can be detected using tools.[5] The beginning of Ramadhan and Shawwal can already be known by adherents of the *hisab* method, while the adherents of the *ru'yah* method have to wait for the citing of each new moon (*hilal)*.

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[1] Fatmawati Fatmawati et al. (2022), "Determination of Islamic Month Start by Moonsighting Australia (Case Study: 1 Dzulhijah 1441)," *Journal of Islamic Thought and Civilization*, Vol. 12, No. 2, pp. 225-241.
[2] Ach Mulyadi (2011), "Melacak Geneologi Sistem Dan Penerapan Mazhab Hisab Pesantren Karay Ganding Sumenep," *Jurnal Penelitian Ilmu Sosial Dan Keagamaan Islam*, Vol. 8, No. 1, pp. 1-20.
[3] Jamaluddin Abdurraziq (2005), "At-Taqwim Al-Qamari Al-Islami Al-Muwahhad Bidayah Al-Yaum Wa Ru'yah Al-Hilal Min as-Satil," in Husain Basri (ed.), *Asy-Syuhur Al-Qamariah Wa at-Taqwim Al-Islami*, Rabat: ISESCO, pp. 14-22.
[4] *Mathla'* means the place where the sun rises, the dawn rises, or the moon rises. Meanwhile, in terms of astronomy, *matla'* is the area boundary based on the range of sightings of the hilal, the geographical limit of the validity of the results of the sightings or regarding the rising of the hilal (crescent) to determine the beginning and end of the Hijri months, Muchtar Salimi (2005), "Visibilitas Hilal Minimum: Studi Komparatif Antara Kriteria Depag RI dan Astronomi," *Jurnal Penelitian Humaniora*, Vol. 6, No. 1, pp. 123-145. In applying the rukyat concept in Indonesia, some argue that *matla'* that applies in a single area of al-hukmi is often called "*local matla*," Read more on Muhammad Hadi Bashori (2015), *Pengantar Ilmu Falak*, Jakarta; Pustaka al-Kautsar, p. 195.
[5] Abdul Mufid (2019), *Moderasi Beragama, Perspektif Yusuf Al-Qaradawi: Kajian Interdisipliner Tentang Wacana Penyatuan Hari Raya*, Purwokerto: CV. Pena Persada, p. 15.

The unification of the Hijri calendar necessitates consensus on the scope of its applicability, the criteria for enforcement, and the authoritative framework. This consensus should be achieved through a multidisciplinary approach involving fields such as jurisprudence (fiqh), astronomy, and socio-politics.[6] The discussion surrounding this Hijri calendar in the Islamic world is intricately linked to the methodology employed in establishing the commencement of the lunar month.[7] Efforts to the unification should be gradual.[8] In Indonesia, there are several criteria from the two methods, namely *wujudul hilal, rukyatul hilal* and *imkān ar-ru'yah*, but in its application, *ru'yatul hilal* follows the *imkān ar-ru'yah* system, so that in the community there are two criteria left, namely *wujudul hilal* and *imkān ar-ru'yah*. Since 1997, the *imkān ar-ru'yah* method was agreed by \ (Ministers of Religious Affairs of Brunei, Indonesia, Malaysia and Singapore) as an effort to unify the Hijri calendar with the criteria of 2° hilal altitude, 3° elongation and 8 hours of hilal age. Furthermore, the position of the hilal towards the sun affects the visibility of the hilal. The closer the distance of the sun from the hilal, the harder it becomes to sight the hilal because the bias is increasing. Therefore, the *imkān ar-ru'yah* Neo-MABIMS 2022 is further introduced to accommodate the hilal visibility at the high level of 3º elongation or the angle of inclination of the hilal 6,4º which is also used by *ru'yah* experts to reckon the beginning of lunar months.

Several studies on MABIMS have been conducted. Since the Indonesian Government sought to determine the altitude of the crescent moon at the beginning of Ramadhan (the old MABIMS criterion) for the duration of 10 years (30 months) and using the criterion of *Wujud al-Hilal*, Shawwal, and Zulhijah 1441-1450 *Hijri*, has appeared 17 times.[9] Previous studies[10] suggest that the Minister of Religion could use the *imkān ar-ru'yah* MABIMS to decide the early setting of Ramadhan. Such a criterion provides limits for *rukyah al-hilal* to determine the initial entry of the month from the results of astronomical calculations. As a result, the MABIMS criterion needs to be revised. Nevertheless, others[11] emphasised that MABIMS is still unable to unify the differences in the determination of the beginning of the month across Indonesia because each group still has different approaches to understanding Islamic texts. This has frustrated attempts to unify the Islamic calendar across Indonesia because of disparities in determining the beginning of the month between the MABIMS and *wujud al-hilal* methods. Such disparities will only grow with time.

So far, several studies[12] have examined the new neo-MABIMS criteria which are focused on one lunar year, with several of those studies being comparative in nature.[13] By contrast, this study will forecast the next 10 years of *hilal* altitude and elongation angle after the application of the 2022 Neo-MABIMS criteria. It also aims to determine the beginning of the month of Ramadhan and Shawwal using the *imkān ar-ru'yah* Neo-MABIMS and compare it to *hisab wujudul hilal*. The result will identify the differences that occur in the onset of Ramadhan and Shawwal between the *imkān ar-ru'yah* Neo-MABIMS and *hisab wujudul hilal*. This study's findings can provide valuable information regarding the position of the hilal. It can be used as a basis to determine the start of Ramadhan and Shawwal. Furthermore, it can contribute to society by helping to identify differences earlier, which will foster a sense of tolerance.

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[6] Abdul Mufid and Thomas Djamaluddin (2023), "The Implementation of New Minister of Religion of Brunei, Indonesia, Malaysia, and Singapore Criteria towards the Hijri Calendar Unification," *HTS Teologiese Studies/Theological Studies*, Vol. 79, No. 1, pp. 45-67.

[7] Maskufa (2017), "Global Hijriyah Calendar As Challenges Fikih Astronomy," in Proceedings of 1st International Conference of Law and Justice - Good Governance and Human Rights in Muslim Countries: Experiences and Challenges (ICLJ 2017), *Atlantis Press*, pp. 188-192.

[8] Abdul Mufid et al. (2020), "Unification of Global Hijri Calendar in Indonesia: An Effort to Preserve the Maqasid Sunnah of the Prophet (Saw)," *Journal of Islamic Thought and Civilization*, Vol. 10, No. 2, pp. 18-36.

[9] Shofwatul Aini (2022), "A Discourse of MABIMS New Criteria (Reading Difference Frequency Between Wujud Al-Hilal and Imkan Ar-Rukyat)," *Justicia Islamica: Jurnal Kajian Hukum Dan Sosial*, Vol. 19, No. 1, pp. 113-131.

[10] M. Raharto and N. Sopwan (2019), "Umur Bulan Sebagai Parameter Visibilitas Hilal," in Prosiding Seminar Nasional Fisika (SNF), Malang: Universitas Negeri Malang, pp. 26-29; Mohd Jais Anuar Ahmad and Baharrudin Zainal (2020), "Penilaian Semula Stesen Rujukan Takwim Hijri Malaysia [Review of Hijri Malaysia Calendar Reference Station]," *Asian Journal of Civilizational Studies (AJOCS)*, Vol. 2, No. 2, pp. 34-47; Fika Afhamul Fuscha (2021), "Verification of The Hisab Ephemeris System Against The Hijri Calendar Leap Year Pattern With Criteria Imkan Al-Rukyah Mabims (Case Study in Kudus District)," *Al-Hilal: Journal of Islamic Astronomy,* Vol. 3, No. 1, pp. 107-128.

[11] Shofwatul Aini (2022), "A Discourse of MABIMS New Criteria (Reading Difference Frequency Between Wujud al-Hilal and Imkan ar-Rukyat)," *Justicia Islamica*, Vol. 19, No. 1, pp. 113-131; Hariyono Hari Yono dan Nursodik Nursodik (2021), "Problematika Penerapan Neo Mabims Dalam Penentuan Awal Bulan Ramadan, Syawal Dan Dzulhijjah 1443 H Di Indonesia," *Jurnal Al-Fatih*, Vol. 4, No. 2, pp. 358-373; Wahidi Ahmad et al. (2021), "Implementation of the Mabims Criteria in Determining the Beginning of Islamic Month in Indonesia and Brunei Darussalam," in Proceedings of the International Conference on Engineering, Technology and Social Science (ICONETOS 2020), pp. 96-108.

[12] Muthi'ah Hijriyati and Ahmad Fakhruddin Fajrul Islam (2023), "Implications of Neo-Mabims Criteria in Determining 1 Dzulhijjah 1443 H (Critical Study of the Matla' Concept in Hadith)," *Azimuth: Journal of Islamic Astronomy*, Vol. 4, No. 1, pp. 1-29.

[13] Nuril Farida Maratus (2022), "Implementasi Neo Visibilitas Hilal MABIMS Di Indonesia (Studi Penetapan Awal Bulan Ramadan Dan Syawal 1443 H)," *Ahkam,* Vol. 10, No. 2, pp. 227-250.

The study is organized as follows: a literature review explaining the *hisab* and *ru'yah* methods, as well as Neo-MABIMS, is presented in the next section. This is followed by the results and discussion, with the method used in the study being outlined thereafter. The final section of the study is a conclusion that contains the inference, implication, and direction for future studies.

Literature Review

Hisab and its Criteria

Hisab refers to arithmetic, which is a science that discusses calculations.[14] The term this is often synonymous with the system of determining the beginning of the lunar month or the Hijri calendar based on cosmic calculations.

Hisab method reaches the level of accuracy of astronomical calculations. It can be seen when the conjunction occurs as the main requirement for the entry of a new moon. The coordination and accuracy of the movement of heavenly bodies can be calculated as stated in QS 10:5.

> هُوَ الَّذِيْ جَعَلَ الشَّمْسَ ضِيَآءً وَّالْقَمَرَ نُوْرًا وَّقَدَّرَهٗ مَنَازِلَ لِتَعْلَمُوْا عَدَدَ السِّنِيْنَ وَالْحِسَابَۗ مَا خَلَقَ اللّٰهُ ذٰلِكَ اِلَّا بِالْحَقِّۗ يُفَصِّلُ الْاٰيٰتِ لِقَوْمٍ يَّعْلَمُوْنَ
>
> "It is He who made the sun a shining light and the moon a derived light and determined for it phases - that you may know the number of years and account [of time]. Allah has not created this except in truth. He details the signs for a people who know."

After performing *hisab*, several considerations related to the moon and the sun must be taken into account. These include determining the time of *ijtima* (conjunction), sunset time, the altitude of the moon at sunset, the size of the angle of elongation of the moon - the sun, the length of the new moon above the horizon, and more. These factors are used to determine whether or not the month has started. *Hisab* requires a criterion for the start of the month, which can be determined using one of three criteria for determining the beginning of the Hijri month.

a) *Ijtima' Qablal Ghurub* means the determination of the beginning of the month is made if the *ijtima'* occurs before sunset.
b) *Wujudul hilal* means the sunset is earlier than the moon, and the moon has a positive altitude value.
c) *Imkān ar-ru'yah* refers to the criteria used to determine the visibility of the *hilal* (the crescent moon). This criteria is enacted and implemented by the government, specifically the Ministry of Religion. When implementing this criteria, it is ensured that the appearance of the new moon is not ruled out. The criteria for the new moon to appear is based on several factors, including the altitude of the new moon being at least 3° and the angle of elongation being 6.4°. This criterion is known as *imkān ar-ru'yah* neo-MABIMS 2022.

Imkān Ar-Ru'yah and Its Criteria

Ru'yah is that seeing with the eye.[15] While in the science of astronomy, *ru'yah* is known as observation. *Ru'yah* determines the beginning of the lunar month, especially the months of Ramadhan, Shawwal, and Zulhijah, as implied in Hadith Sahih is compiled by al-Bukhari and Muslim:

> لاَ تَصُو مُوا حَتَّى تَرَوْا الْهِلاَلَ وَلاَ تُفْطِرُ وْا حَتَّى تَرَوْهُ فَإِنْ غُمَّ عَلَيْكُمْ فَاقْدُرُوْا لَهُ (رواه البخاري ومسلم عن ابن عمر)
>
> "Do not fast (Ramadan) until you see the date (one Ramadhan) and do not break the fast (ending the Ramadhan fast) until the date (one Shawwal). If it is obstructed by a cloud, then making estimation."

The *Ru'yah* method is performed before sunset, as the *ijtima'* occurs when the moon is on the western horizon and sets soon after sunset. The observation of the *hilal's* appearance using the *imkān ar-ru'yah* method is done on the 29th day, when the *hilal* is visible on the western horizon. If the *hilal* is visible, it is considered the first day, and if it is not visible, the moon is considered to have completed 30 days.[16]

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[14] Muhammad Hadi Bashori (2015), *Pengantar Ilmu Falak*, Jakarta: Pustaka al-kautsar, p. 25.
[15] Atabik Ali and Ahmad Zuhdi Muhdlor (2006), *Kamus Kontemporer Arab-Indonesia* Yogyakarta: Yayasan Ali Maksum Ponpes Krapyak, p. 30; Susiknan Azhari (2005), *Ensiklopedi Hisab Rukyat*, Yogyakarta: Pustaka Pelajar, p. 27.
[16] Abu Sabda (2019), *Ilmu Falak: Rumusan Syar'i Dan Astronomi*, Bandung: Persis Pers, p. 13.

The emergence of the *ru'yah* method has been a topic of discussion among jurisprudence scholars such as Al-Qalyubi, Al-Syarwani, and Al-Subkhi, who are considered pioneers in the field. The *imkān ar-ru'yah* is an effort to combine the mazhab between *hilal* and *ru'yah*. It is the basis for synchronizing the results with the *hisab* method. Mansur al-Batawi, in his book Sulam al-Nayyirain, stated that one of the criteria for *imkān ar-ru'yah* is the height of the crescent, which is 2/3 *manzilah*. One *manzilah* is equal to 13°. Some scholars believe that the height should be about 7 degrees or the height of the new moon should be at least 6°.[17] In Indonesia, since 1997, the sighting of the new moon to determine the start of a new Islamic month follows the MABIMS criteria (Ministry of Religion of Brunei Darussalam, Indonesia, Malaysia, and Singapore). The criteria includes a minimum *hilal* height of 2°, an angular distance between the sun and moon of about 3°, and the age of the moon to be at least 8 hours. This standard setting is based on a proposal and recommendations from the Indonesian Government. The analysis of data on September 16, 1974, was from three locations with ten witnesses, and without interference from the planet Venus. The height of the new moon was 2.19°, the angular distance between the moon and sun was 6.8°, and the age of the *hilal* was 8.08 hours.

History of the Formation of the New Neo-MABIMS 2022 Criteria

The Indonesian Ulama Council Fatwa No. 2/2004 recommended "For the Indonesian Ulama Council to make efforts to have criteria for the start of the month of Ramadan, Shawwal and Dzulhijjah to be used as a guideline by the Minister of Religion by discussing it with Islamic organizations and related experts." Sometimes, there is hostility between people due to different interpretations of the arguments related to *hisab* (calculations) and *ru'yah* (sighting of the moon). To address this issue, the MUI (Majelis Ulama Indonesia) believes it is necessary to establish new criteria for combining the two methods. This new method is known as the *imkān ar-ru'yah* method.[18]

The current criteria used to determine the beginning of the Hijri month are the 2-3-8 or MABIMS criteria. They are as follows: (1) the moon must be at least 2 degrees high, (2) the angular distance between the Moon and the Sun should be 3 degrees, or (3) the length of the moon should be at least 8 hours. These criteria were established after the Hisab Rukyat Working Conference in 1997/1998[19] and were implemented in March 1998. However, there are still differences in society, especially in Islamic mass organizations in Indonesia, and Astronomy is also a problem.

The Coordination of Rukyat and Islamic Calendar MABIMS met on Wednesday Pahing to/d Friday Wage, 27-29 June 2012 / 7-9 Sha'ban 1433 Hijria in Bali, Indonesia. The meeting resulted in six conclusions about the "Unification Islamic calendar." They suggested reviewing the MABIMS criteria with the "Crescent Visibility Theory" to determine the beginning of the Hijri month. This later became known as the MABIMS crescent visibility term.[20]

In May 2014, the 15th MABIMS Member Rukyat and Islamic Calendar Muzakarah took place. The event aimed to establish a standard agreement on the criteria used to determine the beginning of the qamari month. Participants also conducted joint observations related to the beginning of the month of qamari including Ramadhan, Shawwal, and Dzulhijah.[21] The focus of the discussion was on hilal visibility criteria such as height and elongation. Each delegation submitted proposals for changes to the criteria, and the criteria proposed by each delegation were different. The proposed criteria can be seen in Table 1.

[17] Ahmad Izzuddin (2012), "Kesepakatan untuk Kebersamaan; Sebuah Syarat Mutlak Menuju Unifikasi Kalender Hijriyah," in Kumpulan Paper Lokakarya Internasional Penyatuan Kalender Hijriah (Sebuah Upaya Pencarian Kriteria Hilal yang Objektif Ilmiah), Semarang: ELSA, p. 156.

[18] Arino Bemi Sado (2015), "Analisis Fatwa MUI Nomor 2 Tahun 2004 Tentang Penetapan Awal Ramadhan, Syawal Dan Dzulhijjah Dengan Pendekatan Hermeneutika Schleiermacher," *Istinbath, Jurnal Hukum Islam*, Vol. 14, No. 1, pp. 64-84.

[19] The complete decisions are: (1) the initial determination of the lunar month is based on *imkān ar-ru'yah*, although there are no reports *of ru'yatulhilal*. (2) *imkān ar-ru'yah* what is meant is based on the height of the new moon of 2 degrees and the age of the moon 8 hours from the time of ijtima at sunset, (3) the height of the new moon is based on the results of the calculation of the hakiki tahkiki reckoning system, and (4) reports of ru'yatul hilal which is less than 2 degrees can be rejected. Read more on Ahmad Izzuddin (2007), *Fiqih Hisab Rukyat*, Jakarta: Erlangga, p. 158.

[20] Ahmad Izzuddin (2012), "Kesepakatan untuk Kebersamaan; Sebuah Syarat Mutlak Menuju Unifikasi Kalender Hijriyah," in Kumpulan Paper Lokakarya Internasional Penyatuan Kalender Hijriah (Sebuah Upaya Pencarian Kriteria Hilal yang Objektif Ilmiah), Semarang: ELSA, p. 100.

[21] There were three decisions at the 15th MABIMS meeting, namely the beginning of Ramadhan, Shawwal, and Zulhijjah 1435 H/2014 AD (Fadholi, 2018)., Study of hilal observation data (ru'yatul hilal) in 2011-2013, representative locations for *ru'yatulhilal* in member countries, and building an agreement on criteria and *wilayahtul hukmi* in determining the beginning of the lunar month, Read more on Ahmad Fadholi (2018), "Pandangan Ormas Islam Terhadap Draf Kriteria Baru Penentuan Kalender Hijriah Di Indonesia," *Istinbáth Jurnal of Islamic Law*, Vol. 18, No. 1, pp. 198-220.

Discussions regarding the new *hilal* visibility criteria or *imkān ar-ru'yah* were held at a national level meeting in Jakarta. The meeting took place on Friday Kliwon to Saturday Legi, August 14 to 15, 2015 / 29-30 Shawwal 1436 Hijri. The meeting was titled "Unification of Methods for Determining the Beginning of Ramadhan, Shawwal, dan Zulhijjah." The Indonesian Ministry of Religious Affairs, the Indonesian Ulama Council (MUI), and Islamic organizations from all over Indonesia participated in the meeting at Wisma Aceh. Later in the same month, astronomers also held a meeting on Friday Pahing, August 21, 2015/6 Zulqa'dah 1436 Hijri at The Hive Jakarta Hotel. The main agenda of the meeting was to discuss the criteria for determining the start of the Hijri month. The results of this discussion will be submitted to the MUI before the 2015 M national meeting. The proposed draft "MUI Criteria" suggests that the altitude of the new moon should be 3 degrees and the elongation should be 6.4 degrees. The proposed criteria will be used as a new guideline to determine the initial hijri month.[22]

Table 1: The Proposal of MABIMS Member Criteria for the 15th Muzakarah Ru'yah and Islamic Calendar

Country	Proposal of Hilal Altitude	Elongation sun and moon	Age of moon
Malaysia	3°	5°	-
Brunei Darussalam	5° 0' 4"[23]	-	19 hours and 13 minutes
Singapore (First proposal)	4° 47'	9° 23'	-
Singapore (Second proposal)	7° 36'	7°	-
Singapore (Third proposal)	5° 30'	7° 30'	8 hours[24]
Indonesia	4°/ 3° 10' (rounded 3°)[25]	6,4°	-

In August 2016, the 16th Muzakarah of the Ministers of Religion of Brunei Darussalam, Indonesia, Malaysia, and Singapore (MABIMS) took place in Teluk Kemang Negeri Sembilan, Malaysia. The meeting was a follow-up to the 15th meeting and included discussions on improving the criteria of *imkān ar-ru'yah* MABIMS (2,3,8), as well as the imaging process in *ru'yatul hilal* according to the perspective of syarak and the global hijri calendar. The main focus was on the issue of Islamic Takwim. After deliberation, the attendees agreed to produce a draft proposal and agree on "New MABIMS Criteria" with the results to be implemented soon:

a) *Imkān ar-ru'yah* Criteria for MABIMS member countries in determining the *Hijri* calendar and the beginning of the hijri month is: "When the sun sets, the height of the crescent moon is not less than 3° from the horizon, and the distance of the curve (elongation angle) of the moon to the sun is not less than 6,4°."
b) The curve distance parameter (elongation angle) referred to is from the moon's centre to the sun's centre,[26] even in this *taqwim*, this new criterion will be applied in 2018 M/1439 H at point 3. This MABIMS criterion is not immediately put forward but has scientific and academic reasons. The compilation of international *hilal* testimony found that the difference in the moon's height to the sun was the minimum to be observed at sunset was 4º. Because the minimum height of the sun at sunset was -50', then the minimum height of the moon to the sun minus the minimum height of

[22] Ahmad Fadholi (2018), "Pandangan Ormas Islam Terhadap Draf Kriteria Baru Penentuan Kalender Hijriah Di Indonesia," *Istinbáth Jurnal of Islamic Law*, Vol. 18, No. 1, pp. 198-220, Read also Thomas Djamaluddin (2022), "Naskah Akademik Usulan Kriteria Astronomis Penentuan Awal Bulan Hijriyah," accessed on 6 April 2022, at https://tdjamaluddin.wordpress.com/2016/04/19/naskah-akademik-usulan-kriteria-astronomis-penentuan-awal-bulan-hijriyah/

[23] This is based on the results of the recording on Saturday Wage, 29 Ramadhan 1425 H/13 November 2004, when 13.5 minutes after sunset, the new hilal could be seen. Ahmad Fadholi (2018), "Pandangan Ormas Islam Terhadap Draf Kriteria Baru Penentuan Kalender Hijriah Di Indonesia," *Istinbáth Jurnal of Islamic Law*, Vol. 18, No. 1, pp. 198-220.

[24] This criterion refers to Turkey's Istanbul Criteria, with the provision that the beginning of the month begins if at sunset anywhere the height of the Moon is at least 5 degrees and the elongation of the Moon is at least 8 degrees, as long as dawn has not yet risen in New Zealand. Majelis Ulama Singapura (MUIS), Developing Agreement on the Criteria and *wilayatul hukmi* of MABIMS in the Early Determination of the Qamariah Month (paper presented at the Muzakarah Rukyat and Islamic Calendar of MABIMS Member States, May 21 to 23 2014, in Jakarta, Indonesia).

[25] The Indonesian delegation proposed a difference in the altitude of the sun and the new moon of 4 degrees (or 3 degrees and 10 minutes rounded up to 3 degrees), assuming that at sunset, the sun's height is -50 minutes, with an elongation of 6.4 degrees. Presentation of the Indonesian Delegation at the Muzakarah Rukyat and Islamic Takwim of MABIMS Member Countries, May 21 to 23 2014, in Jakarta, Indonesia. (Exposure of the results of an alternative paper on the criteria for hilal visibility based on analysis of sighting data in Indonesia and internationally by Prof. Thomas Djamaluddin).

[26] Draft Decision of Muzakarah Rukyah and Islamic Calendar of the 16th MABIMS Member States on 2-4 August 2016 Baitul Hilal Complex, Port Dickson, Negeri Sembilan, Malaysia.

the sun = 4° – 50' = 3° 10'. The height of the crescent depends on the orientation of the moon's position relative to the sun. For ease of calculation, it is proposed that the minimum height for the new moon is calculated from the moon's centre and rounded up to 3°. For the Elongation angle,[27] the elongation angle is at least 6,4°.[28]

At the MABIMS Falak Expert Meeting, held in Yogyakarta from October 8 to 10, 2019, the agreement of the neo-MABIMS criteria was once again emphasised.[29] The meeting was organized by the Directorate General of Islamic Community Guidance Ministry of Religion and was attended by 70 astronomers from various institutions, including the MABIMS State Delegation, Islamic Organizations, the Ministry of Religion's Falakiyah Institute, Center for Astronomy Studies, and Academics. The theme of the meeting was "Development of Hilal Visibility in the Perspective of Science and Jurisprudence."[30]

The main meeting of MABIMS was held on December 8, 2021, and the new MABIMS criteria were confirmed by the religious ministers of Brunei Darussalam, Indonesia, Malaysia, and Singapore. The recommendation was to agree and confirm the implementation of the New MABIMS *imkān ar-ru'yah* criteria, which includes a height of 3° and elongation of 6.4°. This was previously agreed upon at the 44th MABIMS Senior Officers (SOM) meeting in 2019 in Singapore and will be implemented in the year 1443 Hijri.[31] Each country has a different approach towards implementing the new MABIMS criteria for applications. Malaysia has already started applying and announcing the new criteria on Muharram 1443 Hijri together with the Malaysian Falak Month 2021.[32] On the other hand, Indonesia has announced that it will follow the new MABIMS criteria from 1 Ramadhan, 1 Shawwal, and Zulhijjah 1443 Hijriah, which aims to establish a more unified Islamic calendar for MABIMS countries. On February 25, 2022, the Ministry of Religion of the Republic of Indonesia issued a notification letter stating that the new MABIMS *imkān ar-ru'yah* criteria would be effective and officially used from 2022. The criterion for the height of the new moon is set at 3° with an elongation angle of 6.4°. The letter was addressed to Chancellors of UIN, IAIN, STAIN, Head of BMKG, BRIN, Director-General of Religious Courts, Provincial Office of Ministry of Religion, District Office of Ministry of Religion, Head of BDK, Heads of Religious Research and Development Centers, Leaders of Islamic Organizations, and Leaders of Hisab Rukyat Institutions across Indonesia to notify and socialize its validity. The new criteria were established through a long journey of discussions at the ministry level between the countries and experts, especially in astronomy. Finally, the neo-MABIMS 2022 criteria were agreed upon with the common goal of achieving uniformity of the Hijri calendar for the benefit of the people.

Methodology

This study utilized qualitative methods through document analysis and observation. The data were collected from articles, research papers, and books, and an interview was conducted with Prof Dr. Thomas Djamaluddin, M.Sc, a research professor of Astronomy-Astrophysics in National Research and Innovation Agency (BRIN) and member of the Hijri Calendar Unification Team, Neo-MABIMS. The

[27] According to Fotheringham–Maunder, a minimum of moon elongation of 11° is obtained, equal to the value of aL (elongation of the moon) previously formulated by Ibn Qurrah, Al-Khwarizmi as the leading pioneer deduced the crescent as the Moon that has aL (elongation of the moon) > 9,5°, This value w (Arkanuddin & Sudibyo, 2022)as also consistent when later Andre Danjon carried out ru'yatul hilal in the period 1932–1936 which produced 72 data to understand the effect of aL (moon elongation) on crescent length. Danjon found at aL < 7° the length of the Moon's crescent is zero (the new moon is not formed) and aL = 7° this is the Danjon limit, often referred to as the Danjon limit. See Mutoha Arkanuddin & Muh. Ma'rufin Sudibyo, "Criteria for Indonesian Crescent Visibility Rukyatul Hilal (Rhi) (Concept, Criteria, and Implementation)," accessed on 7 april 2022 at https://media.neliti.com/media/publications/268362-kriteria-visibilitas-hilal-rukyatul-hila-464d6da5.pdf. The minimum condition for moon illumination as a prerequisite for sighting the new moon was first obtained by Danjon (1932, 1936, in Schaefer, 1991), who, based on extrapolation of observational data, stated that at a distance of the moon-sun < 7° 7° hilal impossible to see. Limit 7° This is known as the Danjon limit.

[28] Thomas Djamaluddin (2022)," Menuju Kriteria Baru MABIMS Berbasis Astronomi," accessed on 7 April 2022: https://tdjamaluddin.wordpress.com/2016/10/05/menuju-kriteria-baru-mabims-berbasis-astronomi/.

[29] The content of the recommendation to approve the crescent visibility criteria in point 1 of the Mabims Astronomical Expert Meeting Minutes document, namely: Creating the unification of the Hijri calendar according to the new MABIMS criteria (height 3 degrees, elongation 6.4 degrees).

[30] Kementerian Agama Republik Indonesia (2019), "Temu Pakar Falak Mabims Menag Harap Ada Kesepakatan Metode," accessed on 7 April 2022: https://kemenag.go.id/nasional/temu-pakar-falak-mabims-menag-harap-ada-kesepakatan-metode-vazd1a.

[31] Contents of the MABIMS Unofficial Annual Meeting AD-Referendum, signed by the Minister of Religion on December 2021, which coincides with 1443 Jumadil Akhir.

[32] See the application of the new MABIMS criteria on Prof's blog. Thomas Djamaluddin (2022), "Bismillah, Indonesia Menerapkan Kriteria Baru MABIMS," accessed on 7 April 2022: https://tdjamaluddin.wordpress.com/2022/02/23/bismillah-indonesia-menerapkan-kriteria-baru-mabims/

determination of *hilal* altitude and elongation angle used Starry Night Pro Plus, supported by the application of Accurate Hijri Calculator 2.2. The study employed the method of contemporary *hisab* through the utilization of Starry Night Pro Plus 6. To strengthen the results of data regarding *hilal* height with its elongation angle, Accurate Hijri Calculator 2.2 was also applied. The *imkān ar-ru'yah* criterion of Neo-MABIMS deemed eligible when the *hilal* position reaches the altitude of 3º with an elongation angle of 6.4º. Furthermore, the result of the *imkān ar-ru'yah* was adjusted with the Neo-MABIMS criterion, whether it met the requirements of altitude and elongation. Meanwhile, the method of *hisab wujudul hilal* was also presented. It is always used by some cohorts considering that the sun sets before the moon, even though it is only one minute or less away. If the position of the moon is above the horizon (at sunset throughout Indonesia), no matter how high it is (even if it is only 0.1º), then tomorrow is the first day of the new month. A further analysis was required using a comparative approach. We made a comparison between the results of *imkān ar-ru'yah* and *wujudul hilal*. Finally, this study presented the differences between both methods at the beginning of Ramadan and Shawwal starting from 2023 to 2031.[33]

Results and Discussion

Projection of the Beginning of Ramadhan and Shawwal After Applying the Neo-MABIS

In Indonesia, there is often a difference in determining the feast day; for example, this time, the determination of 1 Ramadhan 1443 H is experiencing a difference; the practitioner of *hilal* method, the beginning month of fasting begins on April 2, 2022, to be precise on Saturday while for the *ru'yah* practitioner, it begins with the assumption of implementing the neo- The MABIMS criteria of 2022, which became effective on April 1, 2022, were determined by looking at reckoning data on 29 Sha'ban 1443. According to the Ministry of Religion's Ephemeris data, the average *hilal* height is between 1 degree to 2 degrees. The new moon height for Banda Aceh, located in the east end area (East Indonesia Time), is 2º 4.40'. However, the highest altitude is in Bengkulu, at 2º 10.02'. The height of the new moon at sunset is an average of 1.25º for eastern Indonesia, 1.75º for central Indonesia, and 2.0º to 2.25º for the western part of the country.[34] It has been determined that on Friday, April 1st, 2022, which is the 29th day of Sha'ban 1443 H, the new moon will not be visible. This is due to the *hilal* height being below 3º based on the *imkān ar-ru'yah* neo-MABIMS criteria. As a result, Sha'ban will be completed with 30 days. The Ministry of Religious Affairs has declared that Ramadan 1443 H will start on Sunday, April 3, 2022. This marks a change from previous years, as the new MABIMS criteria has been implemented, which requires a minimum *hilal* height of 3º elongation angle 6.4º. Therefore, there has been a difference in fasting and Eid dates for the community in 2022 compared to the past seven years (2015-2021).

The new neo-MABIMS 2022 criteria will further add to the difference in perceptions of determining the beginning of the lunar month, especially for the determination of the month of Ramadan and Shawwal. The *hilal* height data of this study is presented using the contemporary *hilal* method, using the Starry Night Pro Plus 6 and Accurate Hijri Calculator 2.2. For *mathla'*, the most western region in Indonesia located in the Observatory Tgk Chiek Kuta Karang Lhoknga – Observatory, Lhoknga Aceh Besar District, Aceh Province, with coordinates, latitude = 5° 28' 0.40" North Latitude, Longitude = 95° 14' 31.65" East Longitude, is used. These coordinates are considered because this location is the last area where the sun sets on the western horizon, making it the last limit of *hilal* observation. For the results of *hisab*, the two parameters of the height of the new moon and the elongation angle of the observer's coordinates are used with a topocentric coordinate system.[35] The results of projection are presented in Table 2.

[33] Patrick A. Mello (2021), *Qualitative Comparative Analysis: An Introduction to Research Design and Application*, Washington: Geogetown University Press, p 40.
[34] BMKG (2022), "Map of the Height of the New Moon at the Beginning of Every Qamaria Month 1443/1444 H (2022M)," accessed on 7 April 2022: https://cdn.bmkg.go.id/Web/BUKU-HILAL-2022.pdf.
[35] Topocentric is the position of a point that can be seen quantitatively through the coordinates set in a terrestrial coordinate system with a zero point on the earth's surface.

Table 2. Hilal Altitude and Elongation Angle for the beginning of Ramadan and Shawwal for Ten Years (1444 - 1453 H)

No	Conjunction	The beginning of Ramadhan		1st Ramadhan	Conjunction	The beginning of Shawwal		1st Shawwal
		Hilal Altitude	Elongation Angle			Hilal Altitude	Elongation Angle	
1.	Wednesday, March 22th 2023, Time: 00:23.04 Western Indonesian Time)	8º10'11,46"	9º34'25"	Thursday, March 23th 2023/1444 H, (Concurrent Fasting)	Thursday, April 20th, 2023 11:12:27 Western Indonesian Time	1º43'57,06"	3º5'16"	Criteria for *hilal,* the Appearance of the New Moon Friday, April 21th, 2023 / 1444 H. New MABIMS Criteria Saturday, April 22th, 2023/ 1444 H, (*Istikmal* Fasting).
2.	Sunday, March 10th 2024 Time: 16:06:16 (Western Indonesian Time)	0º 39' 18,6"	1º 48' 27"	Hisab criteria Hilal from Monday, March 11th, 2024,/1445H. Neo-MABIMS Criteria Tuesday, March 12th, 2024 / 1445 H. (sya'ban *Istikmal*)	Tuesday, April 9th, 2024 Time 01:20:48 Western Indonesian Time	6º27'25,74"	9º 21' 14"	Wednesday, April 10th, 2024 /1445 H.
3	Friday, February 28th,2025 Time: 7:44:41 Western Indonesian Time	4º 16' 8,28"	5º 31' 08"	Hisab criteria Hilal from *Saturday March 1st 2025* ,/1446H. Neo-MABIMS Criteria Sunday, March 2th, 2025	Saturday, March 29th, 2025, Time: 17:57:45 Western Indonesian Time	-1º 58' 27,3"	1º 39' 04"	The new moon is still under the horizon; Eid coincides with March 31st, 2025 / 1446 H.

				/ 1446 H (sya'ban *Istikmal*)				
4	Tuesday, February 17th,2026 , Time: 19:01:06 Western Indonesia n Time	-1º 10’ 14,7”	1º 17’ 55”	Crescent Moon under the horizon, Thursday, February 19th, 2026/ 1447 H. (Sya'ban *Ivery often*)	Thursday, March 19th 2026 Time: 08:23:26 Western Indonesia n Time	2º 27’ 3,12”	5º 16’ 56”	Hisab criteria Hilal from Friday, March 20th, 2026 / 1447 H. new MABIMS Criteria, Saturday March 21st, 2026 / 1447 H, (*Istikmal* Fasting).
5	Saturday, February 6th 2027, Time: 22:55:56 Western Indonesia n Time	-3º 53’ 38,58”	3º 22’ 00”	The crescent moon is still below the horizon, fasting together Monday, February 8th 2027 / 1448 H. (*Istikmal* Sha'ban)	Monday, March 8th 2027 , Time: 16:29:24 Western Indonesia n Time	-1º 53’ 45,84”	2º 57’ 08”	The new moon is still under the horizon; Eid coincides with Wednesday, March 10th 2027 /1448 H. (*Istikmal* Fasting)
6	Wednesda y, January 26th 2028, Time: 22:12:26 Western Indonesia n Time	-3º 9’ 26,52”	2º 20’ 22”	Crescent Moon under the horizon, Fasting together Friday, January 28th, 2028 / 1449 H. (*Istikmal* Sha'ban)	Friday, 25 February 2028, Time: 17:37:23 Western Indonesia n Time	-2º 33’ 35,52”	3º 23’ 44”	Crescent Moon under the horizon, Eid at the same time Week February 27 2028 / 1449 H. (*Istikmal* Fasting)
7	Monday, January 15th 2029, Time: 00:24:23 Western Indonesia n Time	6º 23’ 17,4”	8º 28’ 42”	Fasting together Tuesday, January 16 2029/145 0 H.	Tuesday, February 13rd, 2029 , Time: 17:31:23 Western Indonesia n Time	-2º 36’ 10,44”	-3º 51’ 48”	The new moon is still under the horizon; Eid coincides with Thursday, February 15th, 2029, /1450 H. (*Istikmal* Fasting)

8	Friday, January 4th 2030 , Time: 09:49:21 Western Indonesian Time	2º 38'26,64"	4º 41' 33"	Hisab criteria Hilal from Saturday, January 5th, 2030 / 1451 H. new MABIMS Criteria Sunday, January 6th 2030 / 1451 H. (*Istikmal* sya'ban)	Saturday, February 2rd 2030, Time: 23:7:21 Western Indonesian Time	-5º 12' 53,94"	5º 6' 39"	Crescent Moon under the horizon, Eid at the same time Monday February 4th, 2030 / 1451 H.
9	Wednesday, December 25 2030 , Time: 0:32:07 Western Indonesian Time	8º 25' 56,34"	10º23' 32"	Thursday, December 26th, 2030 / 1452 H.	Thursday, January 23th, 203 , Time: 11:30:52 Western Indonesian Time	0º 45' 32,58"	5º 54' 34"	The Appearance of the Hilal Friday, January 24th, 2031/1452 H. New MABIMS criteria Saturday, January 25th, 2031 M/ 1452 H.
10	Friday, December 14th, 2031, Time: 16:05:44 Western Indonesian Time	-0º 56'31,8"	3º 1' 32"	Tuesday December 16th, 2031 / 1453 H.	Tuesday, January 13th, 2032 , Time: 3:6:32 Western Indonesian Time	5º 22' 2,46"	9º 33' 06"	Wednesday, January 14th, 2032, /1453 H.

Upon examining Table 2, it was found that the *hilal* height was approximately 4 degrees, while the elongation angle was 5 degrees. However, this result does not satisfy one of the criteria of Neo-MABIMS, which stipulates that the elongation angle should be 6.4 degrees to potentially differentiate the year 2025 AD. One of the decision-makers of Neo-MABIMS stated that if any of the criteria are not met, the start of the month of Ramadan or Shawwal will certainly be different, as per the interview results.

> The criterion of Neo-MABIMS must meet all parameters. When the *hilal* height is met, the twilight (*shafaq*) disturbance decreases. However, the *hilal* thickness is thinning. This occurrence is due to the elongation angle of less than 6.4 degrees.[36]

[36] Personal Interview with Prof Dr. Thomas Djamaluddin, M.Sc, 19/03/2023. He is research Professor of Astronomy-Astrophysics in National Research and Innovation Agency (BRIN) and Member of the Hijri Calender Unification Team, Neo-MABIMS.

According to Table 2, which shows the conjunction data interval and the magnitude of the height of the first Ramadan and Shawwal from 2023 to 2031, there will be variations in the start dates of Ramadhan and Shawwal. The differences are summarized in Table 3.

Table 3. The result of Projection of Ramadhan 1st and Shawwal 1st

No.	Year	*Hisab Wujudul Hilal*		*Imkanurukyah*		*Note*
		Ramadhan 1st	Shawwal 1st	Ramadhan 1st	Shawwal 1st	
1.	2023 AD/ 1444 H	March 23th	April 21th	March 23th	April 22th	Different Shawwal 1st
2.	2024 AD/ 1445 H	March 11th	April 10th	March 12th	April 10th	Different Ramadhan 1st
3.	2025 AD/ 1446 H	March 1st	March 31th	March 2st	March 31th	Different Ramadhan 1st
4.	2026 AD/ 1447 H	February 19th	March 20th	February 19th	March 21th	Different Shawwal 1st
5.	2027 AD/ 1448 H	February 8th	March 10th 2	February 8th	March 10th 2	No different
6.	2028 AD/ 1449 H	January 28th	February 27th	January 28th	February 27th	No different
7.	2029 AD/ 1450 H	January 16th	February 15th	January 16th	February 15th	No different
8.	2030 AD/ 1451 H	January 5th	February 4th	January 6th	February 4th	Different Ramadhan 1st
9.	2030 AD/ 1452 H	December 26th	January 24th	December 26th	January 25th	Different Shawwal 1st
10.	2031 AD/ 1453 H	December 16th	January 14th	December 16th	January 14th	No different

Table 3 shows that there will be three differences in the beginning of Ramadhan in the years 2024, 2025, and 2030. Indonesian people who follow the *hisab* method will start fasting on March 11th, 2024, while others using *imkān ar-ru'yah* under Neo-MABIMS criteria will fast on March 12th, 2024. In 2025 and 2030, respectively, the differences will repeat, where followers of the *hisab* will fast on March 1, 2025, and January 6th, 2030. A day later, the fasting will be conducted by people embracing the *imkān ar-ru'yah*. However, these differences will not lead to the implementation of different Eid al Fitr day. Adherents of both *hisab* and *ru'yah* will celebrate *Eid al Fitr* together in 2024, 2025, and 2030.

Additionally, the beginning of Shawwal resulting in different Eid al Fitr's celebration will be projected as many as three times in the year 2023, 2026, and 2031. For the remaining four years, everyone will celebrate both Ramadan fasting and Eid worship together.

Finally, the projection of the beginning of Ramadhan and Shawwal in Indonesia after the implementation of Neo-MABIMS criteria shows various heights and elongation angles. It has been found that the beginning of Ramadhan in 2023, 2029, and 2030, as well as the onset of Shawwal in 2024 and 2031, make up the altitude of the crescent moon more than 3° from the horizon, and the distance of the curve (elongation angle) of the moon to the sun above 6.4°.

Conclusion

Due to the increasing *hilal* position and elongation angle, Indonesia has decided to use Neo-MABIMS as a parameter for determining the onset of the lunar month. The criteria established the *hilal* position with an altitude of 3° and an elongation angle of 6.4°. This study found that the eligible criterion with the requirement of Neo-MABIMS is found in three periods for the beginning of Ramadan in the Gregorian calendar, which are in 2023, 2029, and 2030. For the onset of Shawwal, two periods are discovered in 2024 and 2031. This study's findings suggest that there will be differences regarding the beginning of the Ramadhan fasting in 2024, 2025, and 2030. The onset of Shawwal will experience

distinctions by 2023, 2026, and 2030. This indicates that the beginning of 1 Ramadan will be different in 2024 AD/1445 H, 2025 AD/1446 H, and 2030 AD/1451 H, while the beginning of Shawwal will be different in 2023 AD/1444 H, 2026 AD/1447 H, and 2030 AD/1452. After the implementation of NEO-MABIS, the Muslim community in Indonesia will face a day of difference in carrying out the fasting month and Eid al-Fitr. The initial implementation of fasting and Eid al-Fitr is preceded by people using *hisab wujudul hilal*.

The results of this study can help the public understand the potential difference between the beginning of Ramadan and Shawwal, which will occur over the next 10 years. It also provides a policy implication for decision-makers that the Indonesian government, along with the Indonesian Ulama Council (MUI) and Islamic community organizations, should consistently apply Neo-MABIMS to determine the beginning of Ramadan and Shawwal. Once implemented, the hijri calendar can be made for a decade. The findings of this study suggest that the celebration of Islamic feast days may differ depending on whether topocentric or geocentric coordinates are considered, requiring further study by other scholars. This study can be used by experts in astronomy as a topic of socialization and as a corrective material to improve future findings.

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