Reevaluating the -20° Astronomical Dawn Angle: An Islamic Jurisprudential and Astronomical Analysis of *Subh* Time Determination in South Sulawesi

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Abstract

The determination of Subh prayer time is a fundamental issue in Islamic worship, especially when discrepancies arise between astronomical observations and state-mandated criteria. In Indonesia, the Ministry of Religious Affairs adopts a dawn threshold of -20°, which some observational studies suggest occurs earlier than the actual emergence of true dawn (fajr shadiq). This study aims to: (1) describe the method and rationale behind the Ministry's adoption of the -20° standard; (2) analyze the empirical data of dawn appearance at Aparalang Cliff, Bulukumba, South Sulawesi using digital imaging instruments; and (3) evaluate the validity of this standard from the perspective of Islamic jurisprudence, particularly through the lens of wadh'i law. This qualitative research employed observational methods using DSLR camera imagery and image analysis techniques, conducted in July 2023. Findings reveal that true astronomical dawn appeared at approximately -18°, indicating a significant discrepancy from the official standard. The results raise critical jurisprudential questions, as the use of -20° as the legal cause (sabab) for Subh prayer may not align with observable reality, thereby challenging its validity under wadh'i legal theory.

1. Introduction

The accuracy of *Subh* time determination holds a critical position in Islam, not only as the basis for the validity of worship practices but also as a pillar of legal certainty in religious observance that must be safeguarded by religious authorities. As one of the five obligatory daily prayers, *Subh* represents a symbol of spiritual discipline and marks the beginning of a Muslim's daily religious cycle.[1] Inaccuracy in determining *Subh* time has the potential to compromise the validity of worship, disrupt the established structure of religious law, and erode public trust in the decisions made by religious institutions. In a country like Indonesia, where the Ministry of Religious Affairs serves as the primary reference for worship times, the scientific accuracy and juridical legitimacy of each policy are crucial in maintaining public confidence.[2] Consequently, a critical reassessment of the current *Subh* time standard is necessary, integrating empirical astronomical observations with credible Islamic jurisprudential methodologies to ensure the formulation of well-grounded and trusted religious guidance.[3]

Experts in Islamic Astronomy and Astronomy have standardized the appearance of dawn astronomically below the horizon before sunrise [4]. Jabir Al-Battani (d. 317 h) gave the criteria for *syafaq* and dawn -18 °, Abu Raihan Al-Biruni (d. 440 h) the criteria for *syafaq* and dawn -18 °, Ibnu Syatir (d. 777 h) and Jamaluddin Al-Mardiniy (d. 806 h) *syafaq* -17 ° and dawn -19 °, and finally qadhi zadah (d. 840 h) the criteria for *syafaq* and dawn -18 °. The standards for *syafaq* and dawn that apply in several countries including Indonesia vary. First, the Islamic Society of North America (ISNA) standard for *syafaq* is -15 ° and dawn -17.5 °. Second, Muslim Word Language standard *syafaq* ya is -17 ° and fajar -18 °. Third, Egyptian General Authority of Survey standard *syafaq* ya is -17.5 ° and fajar -19.5 °. Fourth, University of Islamic Science, Karachi standard *syafaq* ya is -18 ° and fajar -18 °. Fifth, Malaysia standard *syafaq* ya is -18 ° and fajar -18 °.[5] Sixth, Indonesia standard *syafaq* is -18 ° and fajar -20 °.

[1] Tamhid Amri, 'Waktu Shalat Perspektif Syar 'I', *Asy-Syari'ah* 17, no. 1 (2015). H. 57.
[2] A B D Karim Faiz Faiz and Wahidin Wahidin, 'PRAYER TIME VARIATIONS', *ELFALAKY: Jurnal Ilmu Falak* 6, no. 2 (2022): 207–29.
[3] Abd Karim Faiz and Agus Muchsin, 'Studi Waktu Dhuha Dalam Prespektif Fiqih Dan Hisab Ilmu Falak', *DIKTUM: Jurnal Syariah Dan Hukum* 18, no. 2 (2020): 269–82.
[4] Ahmad Izzuddin, *Fiqh Hisab Rukyah* (Erlangga Publishers, 2007). H. 25.
[5] A B D Karim Faiz Faiz and Nur Awaliyah, 'FROM CLASSICAL TO CONTEMPORARY: A STUDY OF PRAYER TIMES FOR ALL TIME BETWEEN FIQH AND SCIENCE', *ELFALAKY: Jurnal Ilmu Falak* 7, no. 1 (2023): 25–44.

[6]Based on these data, the majority of scholars of Astronomy from the 3rd-8th century Hijriah set the criteria of *syafaq* and fajar -18°, as well as in various other countries the dominant standard *of syafaq* and fajar is -18° . Indonesia, in the provisions of the Ministry of Religion of the Republic of Indonesia in its Contemporary Hisab Based on American Ephemeris Data, [7]has so far set a faster criterion than others for the occurrence of dawn, namely -20° .[8]

The -20° determination by the Ministry of Religion of the Republic of Indonesia has become a polemic in Indonesian society, especially for Muslims. First, the Islamic Sharia Council on April 21, 2021 in its Decree Number: D.063 / QR / DSA-WI / 09/1442 concerning the Determination of Fajar Shadiq criticized the decision of the Indonesian Government, that based on the Results of the 16th *Liqa 'Ilmi* of the Islamic Sharia Council on 14 Jumadil Awal 1438 H / February 11, 2017 M, Fajar Shadiq in its observations was not found and in the decision of the Islamic Sharia Council, Fajar Shajiq was set at -18 °.

Second, research conducted by the Islamic research network team of Universitas Muhammadiyah Prof. Hamka (ISRN UHAMKA) in its research using the Sky Quality Meter (SQM) instrument directed at three positions (Zenith, 45 ° east, and Ufuq East) obtained data that the average value of the true dawn appears at a sun height of - 9.78 °, -11.06 ° and -11.07°. This data shows that the time of dawn prayer in Indonesia with the criteria set by the Indonesian Ministry of Religion is 8 ° 18' faster or equivalent to 33 minutes 12 seconds.[9]

Several previous studies have examined the accuracy of Subh time based on astronomical observations. For instance, a study by Arwin Juli Rakhmadi, Hasrian Rudi Setiawan, and Abu Yazid Raisal (2020), conducted at the Observatory of Islamic Astronomy, Universitas Muhammadiyah Sumatera Utara (OIF UMSU), revealed that the government's -20° standard for Subh time is too early. Using the Sky Quality Meter (SQM), they observed that dawn appeared between -9.78° and -11.07°. This research was conducted in North

[6] Dhani Herdiwijaya, "Dawn Time: A Review of Astronomical Observations," *Tarjih: Journal of Tarjih and the Development of Islamic Thought* 14, no. 1 (2017): 51–64.

[7] Asrini Asrini, "Comparative Study of Contemporary Hisab Ephemeris and Algorithms" (Alauddin State Islamic University Makassar, 2021).

[8] Marataon Ritonga, "The Problem of Syafak and Fajar in Determining the Times of Isyak and Subuh Prayers," *Al-Marshad: Journal of Islamic Astronomy and Related Sciences* 7, no. 2 (2021): 169–82.

[9] Arwin Juli Rakhmadi, Hasrian Rudi Setiawan, and Abu Yazid Raisal, "Measurement of Light Pollution Levels and Early Dawn Time in Oif Umsu Using Sky Quality Meter," *Titian Ilmu: Jurnal Ilmiah Multi Sciences* 12, no. 2 (2020): 58– 65.

Sumatra, an area with relatively high light pollution.[10] Another study by Hafidz Ayatullah (2018) analyzed the false dawn (*fajr kādhib*) and true dawn (*fajr ṣādiq*) in Bone Regency using DSLR cameras to compare actual dawn appearances with mosque prayer schedules. Both studies, however, did not integrate astronomical data with Islamic legal analysis.[11] The novelty of the present study lies in its interdisciplinary approach, combining optical imaging observations of dawn in a low-light pollution area (Aparalang Cliff, Bulukumba, South Sulawesi) with an evaluative analysis based on *wadh'i* jurisprudence. This allows the study to offer a more accurate and legally sound assessment of Subh time determination within the Islamic legal framework.

The problem of the accuracy of the dawn's appearance made researchers interested in studying the dawn phenomenon in the South Sulawesi area, precisely at the Tebing Aparalang location, Bulukumba, South Sulawesi with a digital image observation instrument.[12] This location was determined by researchers because there has been no research in the South Sulawesi region on the dawn phenomenon and this location is very supportive of dawn observation research due to the minimal light pollution based on data obtained on Google Earth.

The problems and discussions in this study, the researcher limits in three formulations of the problem: first, what is the method and basis of the Indonesian Ministry of Religion regarding the determination of dawn -20^{o} in the contemporary calculation of the dawn prayer time. Second, how is the data on the appearance of dawn in Tebing Aparalang, Bulukumba, South Sulawesi circulating digital image instruments. Third, how is the law of dawn data variation from the perspective of *wadh'i* law in the Islamic Law *Istibath* Methodology[13].

Study This aims to describe the method and basis of the Indonesian Ministry of Religion regarding the determination of dawn -20 ^{o} in the calculation of the time of dawn prayer. The second objective is to analyze the data of the appearance of dawn in Tebing

[10] Rakhmadi, Setiawan, and Raisal.

[11] Hafidz Ayatullah, 'STUDI ANALISIS FAJAR KAZIB DAN FAJAR SHADIQ (Awal Waktu Shubuh Di Kabupaten Bone)', *ELFALAKY* 2, no. 1 (2018).

[12] Pierantonio Cinzano, "Night Sky Photometry with Sky Quality Meter," *ISTIL Int. Rep.* 9, no. 1 (2005). H. 73.

[13] Moh Yusuf Faizin, Muhammad Himmatur Riza, and Muhammad Habibur Rahman, 'Dinamika Waktu Imsak Pada Jadwal Imsakiyah Ramadan', *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan* 7, no. 2 (2021): 151–61.

Aparalang, Bulukumba, South Sulawesi based on digital image instruments. The last objective is to describe the methodology of Islamic law regarding the law of dawn data variation from the perspective of *wadh'i law* in the methodology of *istibath of* Islamic Law.

2. Research Method

Research on Reevaluating the -20° Astronomical Dawn Angle: An Islamic Jurisprudential and Astronomical Analysis of *Subh* Time Determination in South Sulawesi is a qualitative research with an observation method on the dawn phenomenon by taking sky images in South Sulawesi. The observation data will then be described using the edge detection method to produce an accurate image of dawn during the research period. This data is then analyzed from the perspective of *wadh'i* law in the *istibath* method of Islamic law.[14]

Collection in this study predominantly uses observation with a Nikon D850 DSLR camera image instrument with Sensor specifications: 45.4MP, Full-frame 35mm; ISO range: 64-25600 (102400 expandable); Viewfinder size/resolution: Optical, 0.75x mag; Video capability: 4K UHD 30FPS on the cliffs of Aparalang, Bulukumba, South Sulawesi. This research in its observations was conducted on the cliffs of Aparalang, Ara Village, Bontobahari District, Bulukumba Regency, South Sulawesi precisely at the coordinates -5 ° 32' 14 "(South Latitude) and 120 ° 25' 50" (East Longitude). The time of the research was conducted in July 2023. This research has two data sources. The first is primary data. The primary data of this study are data and curves from observations with DSLR Camera image instruments which are analyzed using the Edge Detection Method. The second is secondary data. Secondary data in this study are all literature in the form of books and journals related to dawn research.[15] Data analysis in this study is descriptive analytical. The data produced by observing images with a DSLR camera is then analyzed using the Edge Detection Method *and* then described.[16] Furthermore, the data will be analyzed in the perspective of *wadh'i* law in the *istinbath method* of Islamic law.[17]

3. Results and Discussion

[14] Suharsimi Arikunto, "Research Procedures: A Practical Approach," 2013. P. 89.
[15] Albi Anggito and Johan Setiawan, *Qualitative Research Methodology* (CV Jejak (Jejak Publisher), 2018). P. 105.
[16] Pandu Pribadi, MT Muchlas, and Yudhiakto Pramudya, "DETERMINATION OF THE INITIAL TIME OF DAWN AND ISYA PRAYERS BASED ON COMPARISON OF SKY BRIGHTNESS LEVELS," nd
[17] Dameis Surya Anggara and Candra Abdillah, "Research Methods" (Unpam Press, 2019). P. 205.

A. Dawn Observation at Aparalang Cliff, Bulukumba, South Sulawesi

Dawn observation was conducted by researchers precisely on a high hill in Bulukumba, Tebing Aparalang Area with coordinate specifications of -5 ° 32' 14" (South Latitude) and 120 ° 25' 50" (East Longitude) precisely on July 29, 2023 and observations were conducted at the LD Rent Outdoor and Rest Area location, Tebing Aparalang Area, Bulukumba.[18] Dawn observation was conducted with clear weather conditions and slightly cloudy skies. Dawn observation was conducted by researchers using a Nikon D850 DSLR Camera with Sensor specifications: 45.4MP, Full-frame 35mm; ISO range: 64-25600 (102400 expandable); Viewfinder size/resolution: Optical, 0.75x mag; Video capability: 4K UHD 30FPS. Dawn observation was conducted by researchers by taking images of the sky on the eastern horizon precisely with the sun's declination at a position of 20 ° 49' 12" north of the equator. Photographing the sky conditions on the eastern *horizon* was conducted by researchers at the sun's position starting from conditions -22°, -21°, -20°, -19°, -18°, -17°, -16°, -15°, and -14°.[19] Images of the sky on the eastern *horizon* as below:

a) Image acquisition at sun position -22 °

The implementation of the photo shoot using the Sun position -22 ° requires knowing the time when the Sun position is -22 °. To find out the time, a calculation is first carried out to determine the time. The calculation is as below [20].

a. Data:

1) Latitude of place (ϕ^x) : -5 ° 32' 14" LS
2) Bujur tempat (λ^x) : 120° 25' 50" BT
3) Deklinasi Matahari (δ^o) : 20° 46' 12" (4 GMT)
4) Equation of time (e) : 0^j -6^m -21^d (4 GMT)
5) Mer Pass : 12^j - e
: 12^j - 0^j -6^m -21^d

[18] Asrini Bahar, 'STUDI KOMPARATI HISAB KONTEMPORER EPHEMERIS DAN ALGORITMA', *HISABUNA: Jurnal Ilmu Falak* 2, no. 2 (2021): 48–72.

[19] Alimuddin Alimuddin, 'HISAB RUKYAT WAKTU SHALAT DALAM HUKUM ISLAM (Perhitungan Secara Astronomi Awal Dan Akhir Waktu Shalat)', *Al Daulah: Jurnal Hukum Pidana Dan Ketatanegaraan* 8, no. 1 (2019): 38–51.

[20] ABD Karim Faiz, *PRAYER TIMES (FIQIH AND ASTRONOMY STUDY)* (ABD. Karim Faiz, 2021). P. 97.

: $12^{h}6^{m}21^{s}$

6) Interpolation : $(\lambda^{x} - \lambda^{d}) / 15$

: $(120^{o}25' 50'' - 120^{o}) / 15$

: $0^{h}1^{m}43.40^{s}$

b. Time Angle (t)[21]

Cos t = -tan ϕ ^{x} x tan δ ^{or} + sin h-22 ^{or} / cos ϕ ^{x} / cos δ ^{o}

Shift Cos (-tan (-5 ^{or} 32' 14") x tan (20 ° 46 ' 12") + sin (-22°) / cos (-5 ^{or} 32' 14") / cos (20 ° 46 ' 12")

t = 111 ° 27 ′ 14.45"

Mer pass = $12^{h}6^{m}21^{s}$

t / 15 = $7^{h}25^{m}48.96^{s}$ -

= $4^{h}40^{m}32.04^{s}$

Interpolation = $0^{h}1^{m}34^{s}$ -

= $4^{h}38^{m}58.04^{s}$

c. Results of time determination and observation images

The time when the Sun's position was -22 ^{o} at the research observation location was at $4^{h}38^{m}58.04^{d}$ WITA. The results of the sky image at that time are in Figure 9.

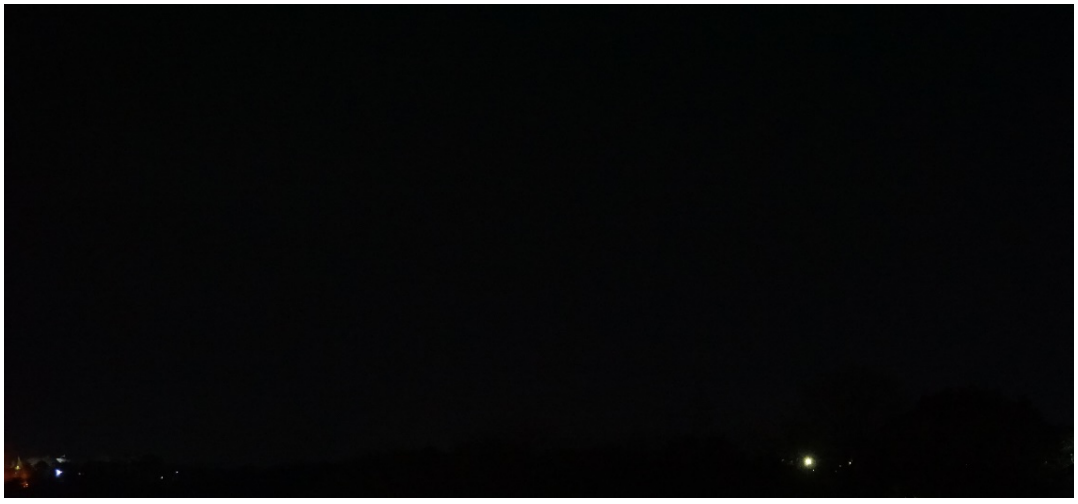


Figure 9. Sky image on the eastern *horizon* at $4^{h}38^{m}58.04^{d}$ WITA

[21] ABD Karim Faiz Faiz and Wahidin Wahidin, "PRAYER TIME VARIATIONS," *ELFALAKY: Journal of Astronomy* 6, no. 2 (2022): 207–29.

b) Image acquisition at sun position -21 ^{o}

The implementation of the shooting at the position of the Sun -21 ^{o} requires knowing the time when the position of the Sun is -21 ^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{o} + sin h-22 ^{o} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5^{o} 32’ 14”) x tan (20° 46’ 12”) + sin (-21°) / cos (-5^{o} 32’ 14”) / cos (20° 46’ 12”)

t = 110° 23’ 1.37”

Mer pass = 12^{j} 6^{m} 21^{d}

t / 15 = 7^{j} 21^{m} 32.09^{d} -

= 4 ^{h} 44 ^{m} 48.91 ^{s}

Interpolation = 0 ^{h} 1 ^{m} 34 ^{s} -

= 4 ^{h} 43 ^{m} 14.91 ^{s}

b. Results of time determination and observation images

The time when the sun's position was -21 ^{o} at the research observation location was at 4 ^{h} 43 ^{m} 14.91 ^{d} WITA. The results of the sky image at that time are in Figure 10.



Figure 10. Sky image on the eastern *horizon* at 4 ^{h} 43 ^{m} 14.91 ^{d} WITA

c) Image acquisition at sun position -20 ^{o}

The implementation of the shooting at the position of the Sun -20 ^{o} requires knowing the time when the position of the Sun is -20^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{or} + sin h-20 ^{or} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5 ^{or} 32' 14") x tan (20 ° 46 ' 12") + sin (-20 °) / cos (-5 ^{or} 32' 14") / cos (20 ° 46 ' 12")

t = 109 ° 18 ' 49.21"

Mer pass = 12 ^{h} 6 ^{m} 21 ^{s}

t / 15 = 7 ^{h} 17 ^{m} 15.28 ^{s} -

= 4 ^{h} 49 ^{m} 5.72 ^{s}

Interpolation = 0 ^{h} 1 ^{m} 34 ^{s} -

= 4 ^{h} 47 ^{m} 31.72 ^{s}

b. Results of time determination and observation images

The time when the sun's position was -20 ^{o} at the research observation location was 4 ^{h} 47 ^{m} 31.72 ^{d} WITA. The results of the sky image at that time were

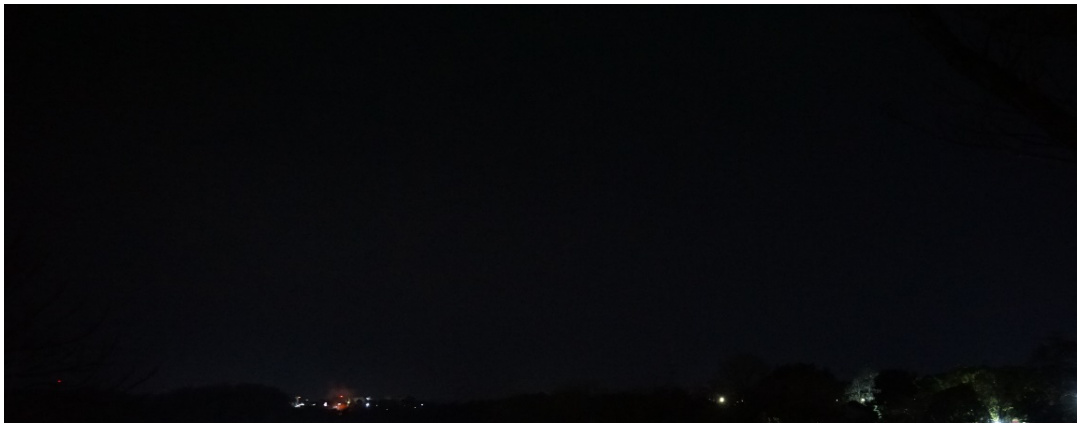


Figure 11. Sky image on the eastern *horizon* at 4 ^{h} 47 ^{m} 31.72 ^{d} WITA

d) Image acquisition at sun position -19 ^{o}

The implementation of the shooting at the position of the Sun -19 ^{o} requires knowing the time when the position of the Sun is -19 ^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{o} + sin h-22 ^{o} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5^{o} 32' 14") x tan (20° 46' 12") + sin (-19°) / cos (-5^{o} 32' 14")

/ cos (20° 46’ 12”)

t = 108° 14’ 37.80”

Mer pass = $12^{j}\ 6^{m}\ 21^{d}$

t / 15 = $7^{j}\ 12^{m}\ 58.52^{d}$ -

= $4^{h}\ 53^{m}\ 22.48^{s}$

Interpolation = $0^{h}\ 1^{m}\ 34^{s}$ -

= $4^{h}\ 51^{m}\ 48.48^{s}$

b. Results of time determination and observation imagery

The time when the sun's position was -19 ^{o} at the research observation location was $4^{h}\ 51^{m}\ 48.48^{d}$ WITA. The results of the sky image at that time were



Figure 12. Sky image on the eastern *horizon* at $4^{h}\ 51^{m}\ 48.48^{d}$ WITA

e) Image acquisition at sun position -18 ^{o}

The implementation of shooting at the position of the Sun -18 ^{o} requires knowing the time when the position of the Sun is -18 ^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{or} + sin h-22 ^{or} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5 ^{or} 32' 14”) x tan (20 ° 46 ' 12”) + sin (-18°) / cos (-5 ^{or} 32' 14”) / cos (20 ° 46 ' 12”)

t = 107 ° 10 ' 26.94”

Mer pass = 12 ^{h} 6 ^{m} 21 ^{s}

t / 15 = 7 ^{h} 8 ^{m} 41.80 ^{s} -

= 4 ^{h} 57 ^{m} 39.20 ^{s}

Interpolation = 0 ^{h} 1 ^{m} 34 ^{s} -

= 4 ^{h} 56 ^{m} 5.20 ^{s}

b. Results of time determination and observation images

The time when the sun's position was -18 ^{o} at the research observation location was at 4 ^{h} 56 ^{m} 5.20 ^{d} WITA. The results of the sky image at that time are in Figure 13.



Figure 13. Sky image on the eastern *horizon* at 4 ^{h} 56 ^{m} 5.20 ^{d} WITA

f) Image acquisition at sun position -17 ^{o}

The implementation of the shooting at the position of the Sun -17 ^{o} requires knowing the time when the position of the Sun is -17 ^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{o} + sin h-22 ^{o} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5^{o} 32’ 14”) x tan (20° 46’ 12”) + sin (-17°) / cos (-5^{o} 32’ 14”) / cos (20° 46’ 12”)

t = 106° 6’ 16.46”

Mer pass = $12^{j}\ 6^{m}\ 21^{d}$

t / 15 = $7^{j}\ 4^{m}\ 25.10^{d}$ -

= $5^{h}\ 1^{m}\ 55.90^{s}$

Interpolation = $0^{h}\ 1^{m}\ 34^{s}$ -

= $5^{h}\ 0^{m}\ 21.90^{s}$

b. Results of time determination and observation images

The time when the sun's position was -17 ^{o} at the research observation location was at $5^{h}\ 0^{m}\ 21.90^{d}$ WITA. The results of the sky image at that time are in Figure 14.



Figure 14. Sky image on the eastern *horizon* at $5^{h}\ 0^{m}\ 21.90^{d}$ WITA.

g) Image acquisition at sun position -16 ^{o}

The implementation of shooting at the position of the Sun -16 ^{o} requires knowing the time when the position of the Sun is -16^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{or} + sin h-22 ^{or} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5 ^{or} 32' 14") x tan (20 ° 46 ' 12") + sin (-16°) / cos (-5 ^{or} 32' 14") / cos (20 ° 46 ' 12")

t = 105 ° 2 ' 6.19"

Mer pass = $12^{h}\ 6^{m}\ 21^{s}$

t / 15 = $7^{h}\ 0^{m}\ 8.41^{s}$ -

= $5^{h}\ 6^{m}\ 12.59^{s}$

Interpolation = 0 h 1 m 34 s -

= 5 h 4 m 38.59 s

b. Results of time determination and observation images

The time when the sun's position was -16 o at the research observation location was at 5 h 4 m 38.59 d WITA. The results of the sky image at that time are in Figure 15.



Figure 15. Sky image on the eastern *horizon* at 5 h 4 m 38.59 d WITA.

h) Image acquisition at sun position -15 o

The implementation of the shooting at the position of the Sun -15 o requires knowing the time when the position of the Sun is -15o. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ x x tan δ o + sin h-22 o / cos ϕ x / cos δ o

= Shift Cos (-tan (-5o 32’ 14”) x tan (20° 46’ 12”) + sin (-15°) / cos (-5o 32’ 14”) / cos (20° 46’ 12”)

t = 103° 57’ 55.96”

Mer pass = 12j 6m 21d

t / 15 = 6j 55m 51.73d -

= 5 h 10 m 29.27 s

Interpolation = 0 h 1 m 34 s -

= 5 h 8 m 55.27 s

b. Results of time determination and observation images

The time when the sun's position was -15 ^{o} at the research observation location was at 5 ^{h} 8 ^{m} 55.27 ^{d} WITA. The results of the sky image at that time are in Figure 16.

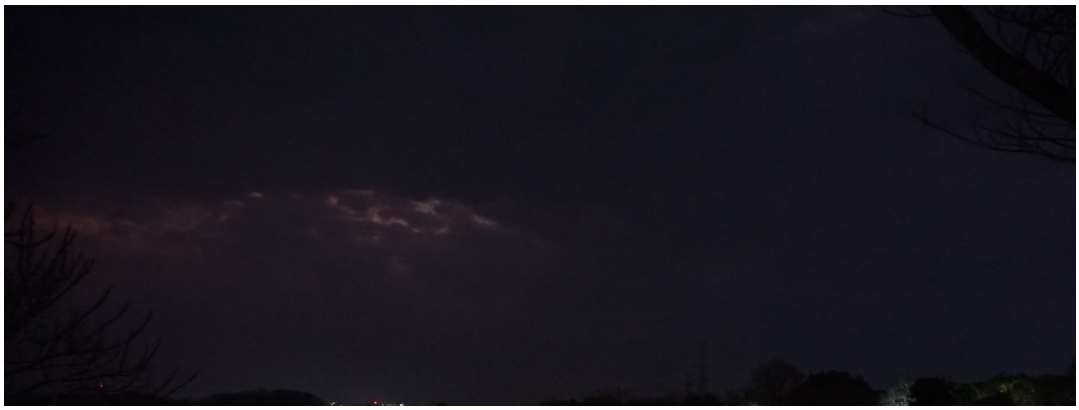


Figure 16. Sky image on the eastern *horizon* at 5 ^{h} 8 ^{m} 55.27 ^{d} WITA.

i) Image acquisition at sun position -14^{o}

The implementation of the shooting at the position of the Sun -14 ^{o} requires knowing the time when the position of the Sun is -14^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{or} + sin h-22 ^{or} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5 ^{or} 32' 14") x tan (20 ° 46 ' 12") + sin (-14°) / cos (-5 ^{or} 32' 14") / cos (20 ° 46 ' 12")

t = 102 ° 53 ′ 45.59"

Mer pass = 12 ^{h} 6 ^{m} 21 ^{s}

t / 15 = 6 ^{h} 51 ^{m} 35.04 ^{s} -

= 5 ^{h} 14 ^{m} 45.96 ^{s}

Interpolation = 0 ^{h} 1 ^{m} 34 ^{s} -

= 5 ^{h} 13 ^{m} 11.96 ^{s}

b. Results of time determination and observation images

The time when the sun's position was -14 ^{o} at the research observation location was at 5 ^{h} 13 ^{m} 11.96 ^{d} WITA. The results of the sky image at that time are in Figure 17.



Figure 17. Sky image on the eastern *horizon* at 5 ^{h} 13 ^{m} 11.96 ^{d} WITA.

j) Image acquisition at sun position -13 ^{o}

The implementation of the shooting at the position of the Sun -13 ^{o} requires knowing the time when the position of the Sun is -13^{o}. To find out the time, a calculation is first carried out to determine the time. The calculation is as below.

a. Time Angle (t)

Cos t = -tan ϕ ^{x} x tan δ ^{o} + sin h-22 ^{o} / cos ϕ ^{x} / cos δ ^{o}

= Shift Cos (-tan (-5^{o} 32’ 14”) x tan (20° 46’ 12”) + sin (-13°) / cos (-5^{o} 32’ 14”) / cos (20° 46’ 12”)

t = 101° 49’ 34.93”

Mer pass = 12^{j} 6^{m} 21^{d}

t / 15 = 6^{j} 47^{m} 18.33^{d} -

= 5 ^{h} 19 ^{m} 2.67 ^{s}

Interpolation = 0 ^{h} 1 ^{m} 34 ^{s} -

= 5 ^{h} 17 ^{m} 28.67 ^{s}

b. Results of time determination and observation images

The time when the sun's position was -13^{o} at the research observation location was at 5 ^{h} 17 ^{m} 28.67 ^{d} WITA. The results of the sky image at that time are in Figure 18.



Figure 18. Sky image on the eastern *horizon* at 5 ^{h} 17 ^{m} 28.67 ^{d} WITA.

The results of the sky image observation are summarized by the researcher in table 1 below. The analysis in table 1 refers to the standardization of dawn in an astronomical perspective. The word dawn in the world of astronomy is called *twilight.*[22]

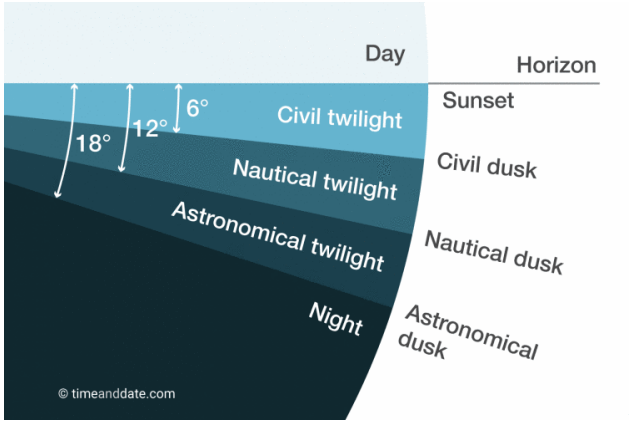


Figure 19. Overview of *twilight levels*[23]

Twilight has multiple meanings, namely: *Civil twilight*, *nautical twilight, astronomical twilight* . [24]The following is an explanation of the three types of twilight: Astronomical Dawn (*Astronomical Twilight*) Astronomical dawn is the end of the night, when the light of the stars begins to fade due to the appearance of the

[22] Andi Muhammad Akmal and Hamzah Hasan, "THOMAS DJAMALUDDIN'S PERSPECTIVE ON THE EXISTENCE OF FAJAR ṢADIQ IN DETERMINING THE BEGINNING," *HISABUNA: Jurnal Ilmu Falak* 3, no. 1 (2022): 149–67.

[23] F Patat, OS Ugolnikov, and OV Postylyakov, "UBVRI Twilight Sky Brightness at ESO-Paranal," *Astronomy & Astrophysics* 455, no. 1 (2006): 385–93.

[24] Lidya Safrida and Machzumy Machzumy, "Analysis of Astronomical Twilight as a Sign of Determining the Beginning of Isha Prayer Time," *Astroislamica: Journal of Islamic Astronomy* 1, no. 1 (2022): 47–72.

scattering of sunlight. At that time the position of the sun's height is about 18 degrees below the horizon, at that time the atmosphere and conditions are still dark and have not been seen more clearly because of the scattering of sunlight by particles. in the air on the eastern horizon it still looks like a white thread (1 hour 12 minutes later the sun will rise).[25]

Nautical Twilight Nautical Dawn is the dawn that appears bright on the eastern horizon for sailors who are approaching land (wanting to land or see land) and at that time the position of the sun's height is around 12 degrees below the horizon (48 minutes later the sun will rise).[26] Civil Twilight Civil dawn is the dawn that begins to show the brightness of objects on the earth's surface and at that time the position of the sun's height is about 6 degrees below the horizon. At that time the atmosphere and conditions are already very bright evenly on the earth's surface where morning activities begin to be carried out by humans, traders, workers, employees, students and others go to their workplaces or activities, then 24 minutes later the sun will rise [27].

Table 1. Description of Sky Conditions During Image Observations on July 29, 2023

No	Altitude of the Sun	Time	Image	Sky Condition Description
1	-22 °	4h 38m 58.04d WITA	Figure 9	The sky conditions in Figure 9 show that it is still dark at night and there is no astronomical dawn (*nautical twilight*) appearing yet.
2	-21 °	4h 43m 14.91s WITA	Figure 10	The sky conditions in Figure 10 show that it is still dark at night and there is no astronomical dawn (*nautical twilight*) appearing yet.
3	-20 °	4h 47m 31.72s WITA	Figure 11	The sky conditions in Figure 11 show that it is still dark at night and that astronomical dawn (*nautical twilight*) has not yet appeared.
4	-19 °	4h 51m 48.48s WITA	Figure 12	The sky conditions in Figure 12 show that it is still dark at night and that astronomical dawn (*nautical twilight*) has not yet

[25] Moch Basthoni, 'A Prototype of True Dawn Observation Automation System', *Jurnal Sains Dirgantara* 18, no. 1 (2021): 33–42.

[26] Alamul Yaqin, 'SOLAR EPHEMERIS ACCORDING TO SIMON NEWCOMB', *Al-Hilal: Journal of Islamic Astronomy* 2, no. 2 (2021): 287–305.

[27] Achmad Mulyadi, "The Experience of Bintaro Gapura Sumenep Fishermen in Determining the Direction of Qibla and Prayer Times (Fiqh Hisab-Rukyat Perspective)," *NUANSA: Journal of Islamic Social and Religious Science Research* 15, no. 2 (2018): 305–20.

				appeared.
5	-18 º	$4^{h}\,56^{m}\,5.20^{s}$ WITA	Figure 13	The sky conditions in Figure 13 show that the night conditions change due to the appearance of light scattering as an early sign of the appearance of astronomical *twilight* .
6	-17 º	$5^{h}\,0^{m}\,21.90^{d}$ WITA	Figure 14	The sky conditions in Figure 14 show that the scattering of light from the emergence of astronomical *twilight* is increasingly abundant and clear.
7	-16 º	$5^{h}\,4^{m}\,38.59^{d}$ WITA	Figure 15	The sky conditions in Figure 15 show that the scattering of astronomical *twilight light* is increasing and becoming clearer.
8	-15 º	$5^{h}\,8^{m}\,55.27^{d}$ WITA	Figure 16	The sky conditions in Figure 16 show that the scattering of astronomical *twilight light* is increasing and becoming clearer.
9	-14 º	$5^{h}\,13^{m}\,11.96^{d}$ WITA	Figure 17	The sky conditions in Figure 17 show that the scattering of astronomical *twilight light* is increasing and becoming clearer.
10	-13 º	$5^{h}\,17^{m}\,28.67^{d}$ WITA	Figure 18	The sky conditions in Figure 18 show that the scattering of astronomical dawn light (*astronomical twilight*) is becoming more and more abundant and clearer and is changing into *nautical twilight* (indicated by the visible appearance of objects around dawn).

B. Reevaluating the Standardization of Dawn -20 º Based on Islamic Law Jurisprudenctial and Astronomical

In Indonesia in general, Subuh begins when the position of the Sun is 20° below the true horizon. This can be seen for example in the opinion of Indonesia's leading astronomer, namely Saadoe'ddin Djambek, who is referred to by many as the *mujaddin al-hisab* (reformer of hisab thought) in Indonesia.[28] He stated that Subuh time begins with the appearance of Dawn below the eastern horizon and ends with the sunrise. According to him, in astronomy, the time of dawn is defined as the position of the Sun 20° below the eastern horizon. Meanwhile, the end of Subuh time

[28] Muhajir Muhajir, 'Analisis Pemikiran Saadoe'ddin Djambek Tentang Waktu Shalat Di Daerah Abnormal (Kutub)', *Madinah: Jurnal Studi Islam* 5, no. 2 (2018): 148–58.

is the time of *Syuruq* (rise)[29], which is -1°.[30]

The calculation results show that every 1° difference in the height of the Sun used as a reference for determining the time of dawn will be equivalent to a 4-minute difference in the start of the prayer. In Indonesia, the ijtihad used is the position of the Sun 20° (degrees) below the horizon. The use of this number is according to the Indonesian Ministry of Religion (1994) based on the opinion of Saadoeddin Djambek (974 AD) in his book on prayer and fasting in the polar regions and Abd. Rachim in his book on astronomy.[31]

The number 20° is actually a number given by Ibn Yunus, a scientist who lived at the same time as al-Biruni. This number is a modification of al-Biruni's findings with adjustments to the sensitivity of the eye in observing the beginning of dawn and the end of dusk. This is based on the idea that the eye's response is more sensitive to observing the gradual change process from dark to light than from light to dark. So this 2° correction number was taken even though the two events were both twilight.[32]

There are 3 factors that affect the appearance of dawn, namely the thickness of the atmosphere, temperature and humidity, but in determining the position of the Sun at dawn it is necessary to conduct direct observation, in order to verify existing theories. In this, the researcher will present the results of observations and research on the appearance of the true dawn / astronomical dawn based on field observations: 1. Observation of Abdul Haq Sultan.[33] The observation was carried out in the Suburban of San'a City (Yemen). The sky conditions were perfect (without clouds or

[29] Sirajuddin Sirajuddin, Azwar Azwar, and Aswar Aswar, 'Analysis of Factors Affect the Differences of the Determination of Fajr Ṣādiq and Its Relevance to the Basic Principles of Sharia', *Kawanua International Journal of Multicultural Studies* 4, no. 1 (2023): 1–15.

[30] Nugroho Eko Atmanto, "The Relevance Concept of Dawn and Twilight in the Book of Al-Qanun Al-Mas' Udi for Determine Isha'and Fajr Pray Time," *Analysis: Journal of Social Science and Religion* 19, no. 1 (2012): 95–105.

[31] Muhammad Shuhufi, Rahma Amir, and Saiyed Amar Ahmad, 'Rumus Arah Kiblat Saadoeddin Djambek Perspektif Spherical Trigonometry', *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan* 6, no. 2 (2020): 149–61.

[32] Saadoeddin Djambek, 'Pedoman Waktu Shalat Sepanjang Masa', *Jakarta: Bulan Bintang*, 1974. P. 54-61.

[33] Agung Danarta, 'Shift in Understanding of The Quran and Hadith about The Early Time of Subuh (Case Study Of Muhammadiyah)', *Jurnal Living Hadis* 6, no. 2 (2022): 161–80.

dust) with the observation point presenting a plateau (2,200 meters above sea level). This observation relies on the naked eye. The height of the true dawn is Minus 19.4.[34] 2. Observation of Kid Shaukat. This observation was carried out near the city of Birmingham (England). The observation point presents a lower altitude (140 meters above sea level). The observation instrument is not explained, as are the sky conditions. The height of the true dawn is Minus 14.22.[35] 3. Observation of Nihayatur Rohmah. The observation carried out was a multi-lacosity observation covering six points.[36] Three points represent the lowlands, namely Kaibon Madium, Tayu Margomulyo Pati and Parangkusumo Bantul. The instrument used is a Canon EOS 400D DSLR camera. The height of the true dawn is Minus 18.65. While for the highlands alone, the observation was carried out in Bendo Ketitang Klaten, the peak of Mount Merbabu, the height of the true dawn is Minus 18.66. For the observation point of Lembang, West Bandung, which is in the highlands, the height of the true dawn is Minus 15.14. [37]4. Observation of Anake Harijadi Noor. This observation was carried out at Tayu Beach, Pati, which is a lowland using the SQM (Sky Quality Meter) tool. The height of the true dawn is Minus 17. Then Anake made another observation in Lembang, West Bandung, which is a highland using the SQM tool. The height of the true dawn is Minus 16 to Minus 17. [38]5. Observation of Eka Puspita Arumaningtyas. Observations were conducted in two areas, each in Bandung-Cimahi which is a highland and Diwek Jombang which is a lowland. The instrument used was SQM. Observations in Bandung and Cimahi obtained a high value of the Sun for the beginning of Fajar shadiq Minus 15. This figure is concluded to be a product of an environment that has been polluted by light to a severe degree so that it is not suitable for observation. While in Diwek Jombang the high number of the sun is

[34] Nihayatur Rohmah, 'Pengaruh Suhu Dan Kelembaban Atmosfer Terhadap Ketampakan Fajar Shadiq', *Al-Mabsut: Jurnal Studi Islam Dan Sosial* 8, no. 2 (2014): 1–14.

[35] Bernard R Goldstein, 'Ibn Mu c Ādh's Treatise On Twilight and the Height of the Atmosphere', *Archive for History of Exact Sciences* 17, no. 2 (1977): 97–118.

[36] Imam Qusthalaani, 'Kajian Fajar Dan Syafaq Perspektif Fikih Dan Astronomi', *Mahkamah: Jurnal Kajian Hukum Islam* 3, no. 1 (2018): 1–16.

[37] Nihayatur Rohmah, "The Influence of Atmospheric Temperature and Humidity on the Appearance of Fajar Sadiq," *Al-Mabsut: Journal of Islamic and Social Studies* 8, no. 2 (2014): 1–14.

[38] Rahnat Hidayat Rahnat, "CHANGES IN THE CRITERIA FOR THE BEGINNING OF THE MUHAMMADIYAH DAWN TIME," *ELFALAKY: Journal of Astronomy* 7, no. 1 (2023): 1–24.

minus 19 in a completely dark environment. 6. Research by the Islamic Science Research Network team, Prof. HAMKA Muhammadiyah University (ISRN UHAMKA) Jakarta, pioneered by Tono Saksono. Observations and research were conducted using the Sky Quality Meter (SQM) instrument which was directed at three positions (Zenith, 45 º east, and Ufuq East) it was found that the average value of the true dawn appeared at a sun height of - 9.78 º, -11.06 º and -11.07 º. his data shows that the time of dawn prayer in Indonesia with the criteria set by the Indonesian Ministry of Religion is 8 o 18' faster or equivalent to 33 minutes 12 seconds.[39]

The observation results above do not show any results of dawn appearing at -20 º.[40] The Indonesian government's decision through the Ministry of Religious Affairs of the Republic of Indonesia regarding the dawn time starting at the condition of the Sun -20 º below the horizon is very contrary to the concept of *wadh'i law* in Islamic Law.[41]

Abdul Karim Zaidan in his work *Al-Wajiz Fi Ushulil Fiqh* states that the law of wadh'i is a relationship when Allah SWT makes something a cause, condition or obstacle for the existence of a law of burden on mukallaf. Whether the burden is in the form of an order, prohibition or choice.[42]

The determination of something that is a cause, condition or obstacle is sometimes in the form of an event caused by the actions of themukallaf or outside of the actions of the *mukallaf*. Events outside the actions of the *mukallaf* There are astronomical phenomena, in this case one of them is dawn which is the cause of the obligation of dawn prayer.[43] The presence of dawn then there is a command to perform dawn prayer, conversely when dawn has not yet occurred then the

[39] Tono Saksono et al., "Premature Dawn around the Globe," in *AIP Conference Proceedings* , vol. 2727 (AIP Publishing, 2023).

[40] Laksmiyanti Annake Harijadi Noor and FFRS Hamdani, 'The Dawn Sky Brightness Observations in the Preliminary Shubuh Prayer Time Determination', *Qudus International Journal of Islamic Studies* 6, no. 1 (2018): 25–37.

[41] Bakhtiar Bakhtiar, Fitra Nelli, and Firdaus Firdaus, 'Disclosure of Ijtihad: The Changes of the Early Time of Dawn as a Sharia and Science Integration Effort', *Jurnal Ilmiah Al-Syir'ah* 20, no. 1 (2022): 16–33.

[42] Wahbah Zuhaili, "Ushul Al-Fiqh Al-Islami," *Beirut: Dar Al-Fikr* , 1986, 38. P. 207.

[43] Nur Hannan et al., 'Between Adherence to Madhhab and Adaptation to Context: Fatwās on Female Leadership in Nahdlatul Ulama-Affiliated Islamic Higher Education Institutions', *Journal of Islamic Law* 5, no. 2 (2024): 269–87, https://doi.org/10.24260/jil.v5i2.2725.

obligation of the command to perform dawn prayer does not yet exist.[44]

The concept of cause in Islamic law regarding dawn for morning prayers is based on QS Al-Isra' verse 78: “Establish prayer from the decline of the sun until the darkness of the night, and (also establish the prayer of) the dawn. Indeed, the dawn prayer is witnessed (by the angels).”[45]

Wahbah Az-Zuhaily in his commentary Al-Munir explains that the word "lam" in the verse indicates the meaning of the reason so that the command to be obligatory in the dawn prayer did not exist when the reason did not exist.[46]

4. Conclusion

The regulation set by the Ministry of Religious Affairs of the Republic of Indonesia regarding the Sun’s position at -20° below the horizon for determining dawn time refers to the opinion of Ibn Yunus during the era of Al-Biruni, specifically between 958 and 1009 AD. Ibn Yunus, whose full name was Abu al-Hasan Ali bin Abi Said Abdurrahman bin Ahmad bin Yunus as-Sadafi, contributed significantly to early Islamic astronomical thought. His work has been historically influential, although the methodologies and observational tools available at that time were limited compared to modern standards.

Recent dawn observations conducted at the Aparalang Cliffs in Bulukumba, South Sulawesi, show that astronomical twilight the earliest visible indication of dawn appears when the Sun is approximately -18° below the horizon. This finding suggests a discrepancy between the government’s -20° standard and actual observational data. Consequently, applying the -20° criterion for Subh prayer time may conflict with the concept of *Wad*‘i law in Islamic jurisprudence, as the *sabab* (legal cause) for the prayer time the observable phenomenon of dawn is not yet present at that position.

[44] Nurul Mahmudah et al., "Wadh'i Law in Synchronization with Taklif Law," *El-Ahli: Journal of Islamic Family Law* 1, no. 2 (2020): 82–100.

[45] Ahmad Zayyadi et al., ‘Understanding of Legal Reform on Sociology of Islamic Law: Its Relevance to Islamic Family Law in Indonesia’, *Al-Manahij: Jurnal Kajian Hukum Islam*, 20 November 2023, 249–62, https://doi.org/10.24090/mnh.v17i2.7584.

[46] Wahbah Az-Zuhaili, “Tafsir Al-Munir: Aqidah, Sharia, Manhaj,” *Jakarta: Gema Insani* , 2013. H. 275

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