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Al-Hisab: Journal of Islamic Astronomy
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Table of Contents

Articles

History And Development Of Astronomy In World Civilization *Mawar Putri, Dinda Puspita Tanjung*	DOWNLOAD PDF HERE 107-113
Determination of prayer time schedule according to abd. Jalil manaf husaini *Suci Puspita Sari, Muhammad Rivaldy, Syahreza Kurniawan*	DOWNLOAD PDF HERE 114-120
Hijri Calendar in Sharia Business Management *Abdul Khoidir Nasution, Wesi Anggriani, Ayu Romadhona*	DOWNLOAD PDF HERE 121-128
The Direction of Sunset as a Reference for Determining the Qibla Direction (Study of Imam Al-Ghazali ‘s Views in the Book of Ihya’ Ulumuddin) *Muhammad Adam, M. Ihtirozun Ni'am*	DOWNLOAD PDF HERE 129-141
The Global Islamic Calendar According to Syamsul Anwar's Thoughts *Dedy Dermawan, Juwita Abdullah*	DOWNLOAD PDF HERE 142-147
The Role of Observatory in Observing and Teaching Astronomy to Students *Ahmad Najamuddin Zulkeflee*	DOWNLOAD PDF HERE 148-153

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History And Development of Astronomy in World Civilization

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ABSTRACT

Astronomy has played a crucial role in the development of Islamic astronomy knowledge. This paper explores the historical contributions of astronomers, the impact of classic astronomy on the broader scientific world, and its relevance in modern times, particularly in determining the Islamic calendar and prayer times. The study also discusses integrating traditional Islamic methods with contemporary astronomical practices. This study uses a qualitative approach to explain the phenomenon in as much depth as possible through data collection from published references. Certain verses in the Qur'an, such as surah Al-Anbiya verse 33 and surah Yasin, specifically mention astronomy. Historically, the development of astronomy has been divided into two phases: before Islam and in Islamic civilization.

To cite this article:

I. Introduction

The development of astronomy has been a vital part of human civilization, with roots tracing back to some of the earliest known cultures. The ancient Egyptians, Babylonians, and Greeks laid much of the groundwork for modern astronomy. The Egyptians, for example, used astronomical observations to align their pyramids and to establish a reliable calendar system essential for agricultural and religious activities [1]. The Babylonians, meanwhile, are credited with some of the earliest systematic observations of celestial bodies, recording the positions of planets and stars, which later influenced Greek astronomy [2].

Astronomy has attracted the attention of researchers and historians due to several factors, such as the contributions of scholars, the number of works, astronomical observatories, and documentation of natural observations. The civilizations of India, Persia, and Greece played a key role in the birth of the Arab (Islamic) Falak civilization. The astronomy book Sindhind from India influenced the development of Arabic astronomy, while the Persian civilization gave astronomical terms still in use, such as zij and auj. Greece's civilization, led by Ptolemy, made a major contribution with his work 'Almagest,' which survived Copernicus' theory. The development of astronomy needs to be studied before and during Islamic civilization.

Islamic astronomy, also known as Ilm al-Falak, has been a significant field of study within the Islamic world for centuries. Rooted in the religious practices of Islam, which require precise knowledge of celestial events, this science has contributed extensively to global astronomical knowledge. The field has historically been crucial for determining prayer times, the Islamic calendar (Hijri), and the direction of the Qibla (the direction of the Kaaba in Mecca) [3].

The legacy of Islamic astronomy extends beyond the medieval period, influencing the European Renaissance and the subsequent development of modern astronomy. The preservation and enhancement of Greek and Indian astronomical knowledge by Islamic scholars provided a crucial link between ancient and modern science. The works of Islamic astronomers were translated into Latin during the 12th century, making their way to Europe, where they were studied by scholars such as Copernicus, who credited them with providing the observational data and mathematical tools necessary for his heliocentric theory [4]. Thus, Islamic astronomy played a pivotal role in the broader history of science, bridging the gap between ancient civilizations and the modern scientific era.

In modern times, Islamic astronomy has integrated traditional methods with contemporary astronomical tools and data. This integration has been particularly evident in observatories like the Observatorium Ilmu Falak UMSU, which combines classical Islamic astronomy with modern technology [5].

II. Method

The type of research used by the author for this research is Library or literature research that explains according to normative, organized, and systematic principles and is accurate in the object of study, which is the subject matter. This study aims to explain the phenomenon as deeply as possible through data collection from published references.

III. Results and Discussion

A. Pre-Islamic Astronomy

The science of astronomy has been studied by nations such as Egypt, Mesopotamia, Babylon, and China since the 28th century B.C. Initially, they studied it to produce a count of time used to worship various idols such as Osiris, Isis, Anom in Egypt, and Astaroth and Bel in Babylon and Mesopotamia. The need for time division encourages them to delve into astronomy. Over time, the field of astronomy discussion developed into an understanding of the sky and everything around it. Ancient civilizations such as Babylon, Egypt, China, India, Persia, and Greece were active in astronomy and astrology, reflecting the character and tendencies of each civilization [6].

The Sumerian civilization, estimated at around 4500 BC, is considered the beginning of the emergence of science, especially in astronomy and astrology, for subsequent civilizations. Babylon, as a continuation of the Sumerians, had a strong influence. The Babylonians were known for their experimental activities, which helped this civilization survive and flourish. Astrology, born around 2,000 BC in the Mesopotamian Valley, became an important contribution and, at the same time, a problem still relevant today in Babylon. The glittering sky inspired astrologers and celestial surveyors without city lights, predicted celestial phenomena, and regarded the motion of celestial bodies as a message from the rulers of nature. Originally intended for kings and countries, astrology eventually permeated the daily lives of ordinary people, discussing predictions, characters, tendencies, joys, and sorrows.

According to one story, the division of a week or seven days has existed for more than 5,000 years. At that time, to avoid confusion, they gave names of known celestial bodies, such as the sun for Sunday, the Moon for Monday, Mars as Thursday, Mercurius as Wednesday, Jupiter as Thursday, Venus as Friday, and Saturn as Saturday.

There are significant differences between astronomy and astrology, although both involve the interpretation of the universe (the sky). These two fields are related to the meaning of celestial bodies. Astrology focuses on the relationship between the positions of the constellations (zodiac), planets, sun, and moon to a person's character and fate. On the other hand, astronomy investigates the movement of celestial bodies scientifically for the benefit of humans and the development of civilization. It also observes galaxies, planets, stars, comets, and other celestial bodies that continue to evolve as human knowledge advances. Astronomy studies natural phenomena such as lunar and solar eclipses, sunspots, and others with a physical-mathematical approach and the laws of nature. In conclusion, the objects in the sky were considered celestial entities, not gods or extraordinary beings.

During the Babylonian civilization, tables of celestial circulation, calendars of the seasons changed, phases of the moon, mapping of the sky, and predictions of eclipses which became the beginning of modern astronomy. This civilization also established a circle measuring 360°, measuring the circumference of the Earth measuring 360°, and determining the division of time with one day equal to 24 hours, 1 hour equal to 60 minutes, and 1 minute equal to 60 seconds. Astronomy had gained a very important and broad position in the Land of Greece, which was in the golden age of knowledge. The names of famous Astrologers before Islam include:

1. Aristoteles (384 – 322 SM)

Aristotle argued that the center of the universe is the Earth, while the Earth is in a state of rest, motionlessness, and non-rotation. All the motions of celestial bodies revolve around the Earth. The trajectory of each celestial body is circular. Meanwhile, eclipse events, for example, are no longer seen as giants swallowing the moon but are natural events. Man's view of the universe from then on generally follows Aristotle's view, namely the geocentric Earth as the center of circulation of celestial bodies

2. Claudius Ptolomeus (140 M)

The opinion put forward by Ptolemy is under Aristotle's view of the cosmos, namely the Geocentric view; the Earth is surrounded by the moon, Mercury, Venus, the sun, Mars, Jupiter, and Saturn. The celestial bodies are far from the Earth in successive distant checks. The trajectory of these celestial bodies is in the form of a circle within a celestial sphere. While the sky is where the true stars are, so they are glued to the walls of the celestial sphere. Ptolemy had a great book on the science of the stars entitled' Syntasis. Ptolemy's geocentric view prevailed until the 6th century A.D. without any change.

The civilizations of India and Persia have an important role in the development of Arabic astronomy (Islam) and coexist with the civilization of Greece [7]. India's influence on Islam is more dominant than that of Persia. An interesting myth from the Ancient Indian nation depicts the Earth as flat, perched on several giant elephants standing on the back of a large turtle. The sky is considered a giant cobra that circles the Earth, its scales glittering like stars at night. The text "Sindhind" from India had a great impact on the development of Arabic (Islamic) astronomy, especially during the Abbasid period (750-1258 AD) under the reign of Al-Manshur. An order was issued to translate this book into Arabic, and Ibrahim al-Fazzari produced an explanatory book entitled "As-Sind Hind al-Kabir." This gave rise to astronomy works with a touch of Indian astronomy during the Abbasid period.

Persian civilization also exerted a significant influence on Islam. They learned from the civilizations of India and others. The Abbasid king, Al-Manshur, gathered Persian astronomers for astronomical discussions, including figures such as Nubekht al-Farisi, Umar bin al-Farkhan, and Ibrahim al-Fazzari. Persian astrological terms such as 'zaij' (zij) and 'auj' (aphelion) remain relevant in Islam. Persian-language astrological books that attracted the attention of Arabic (Islamic) include "Zaij asy-Shah" or 'Zij Syahryaran,' a well-known epilicator (zij) of the time. One of Al-Khawarizmi's works, entitled "Ta'dil al-Kawakib" also reflects the style of the Persian astronomical school.

B. Astronomy in the Islamic Age

The science of astronomy in the classical Muslim intellectual tradition is considered one of the signs of the progress of Islamic civilization. Initially, the science of Falak only focused its study on aspects of worship, such as the direction of the Qibla, the time of prayer, and the beginning of the month of Qamariah. The development of Falak in the Islamic world reached its peak with the process of translating monumental works from Greece, which had a great impact on its evolution. Works such as "The Sphere in Movement" (Al-Kurrah al-Mutharrikah) by Antolycus, "Ascentions of the Signs" (Matali' al-Buruj) by Aratus, "Introduction to Astronomy" (Al-Madkhhal ila Ilmi al-Falak) by Hipparchus, and "Almagesti" by Ptolemaeus greatly influenced Falak's thought [8].

Over time, translating these works and in-depth research produces new theories. At this point, an influential figure in the Muslim community, al-Khawarizmi, emerged with his monumental work, "al-Mukhtasar fi Hisab al-Jabr wa al-Muqabalah." This book had a significant impact on the thought of European scholars. It was later translated into Latin by

Robert Chester in 535 AH/1140 AD under "Liber al-gebras et almucarabah". In 1247 AH/1831 AD, Frederick Rosen translated the book into the United Kingdom. In the Quran, Surah Al Anbiya verse 23 says:

وَهُوَ الَّذِيْ خَلَقَ الَّيْلَ وَالنَّهَارَ وَالشَّمْسَ وَالْقَمَرَۗ كُلٌّ فِيْ فَلَكٍ يَّسْبَحُوْنَ ﴿٣٣﴾

It states, "And it is He who created the night and the day, and the sun and the moon; all [heavenly bodies] in an orbit are swimming." This verse highlights the concept of celestial bodies moving in precise orbits, a fundamental idea in Islamic astronomy, or Ilm al-Falak. Islamic scholars have historically interpreted this verse as an indication of the ordered nature of the universe, which aligns with the scientific understanding of celestial mechanics. The recognition of orbits in the Quran has been viewed as a reflection of the divine knowledge that precedes human discovery, motivating Muslim astronomers to explore and understand the heavens. This Quranic insight has encouraged a tradition of astronomical observation and study in the Islamic world, leading to significant advancements in the field [9].

Under the influence of previous civilizations, astronomy during the Arab civilization (Islam) was initially better known as the study of astrology. The main factors were the habits of living in the desert that involved celestial bodies to know the changes in time, the change of seasons, and the like, as well as their influence on the astrological habits of neighboring nations. During the Abbasid Dynasty, under the rule of Al-Manshur, astronomy was placed in a special position after monotheism, jurisprudence, and medicine. Astronomy at that time was studied for practical purposes of worship and developed as a basic foundation for advancing other sciences such as shipping, agriculture, military, mapping, and others. Caliph Al-Manshur even allocated large funds from the state to develop astronomy studies. During this period, the study of astronomy developed naturally and scientifically with many new improvements and breakthroughs. Muslim astrologers scientifically calculate prayer times, qibla directions, and rukyatul hilal and calculate seasons and other aspects.

From the Umawiyah era to the Al-Makmun period, the movement to translate foreign astronomy literature into Arabic became widespread. Examples are the translation of Miftah an-Nujum based on Hermes the Great, and Sindhind in 154/771 translated by Ibrahim al-Fazzări (d. + 180/796), as well as Ptolemy's "Almagest" translated by Yahya bin Khalid al-Barmaki and perfected by Al-Hajjaj bin Matar and Säbit bin Qurrah (d. 288/901), among other works.

Islam gave birth to many influential astronomers in the world, such as Al-Battani (d. 317/929), Al-Buzjani (d. 387/997), Ibn Yunus (d. 399/1008), Ath-Thūsi (d. 672/1273), Al-Biruni (d. 440/1048), Ibn al-Majdi (d. 850/1446), and others [10]. The development of Arab-Islamic astronomical civilization, as previously highlighted, is not only based on previous civilizations but has certain peculiarities:

a. Although adopted from previous civilizations, the science of astronomy developed in Islamic civilization is always enriched with corrections and re-explanations of theories, producing new works with their characteristics and advantages.

b. The Arab-Islamic astronomical civilization is not limited to a mere theoretical review but expands its scope to other fields of science such as mathematics, physics, geometry, and others. This is reflected in the works and observation tools produced.

c. In the context of astrology, Arab-Islamic civilization did not completely erase this tradition. The practice of astrology is still present in daily life. This is due to astrology, which highlights various aspects of a person's life, including all possible joys and sorrows.

In the 16th century, the geocentric system collapsed thanks to the contribution of Nicholas Copernicus (d. 1543 AD) in 1512 AD. He stated that planets and stars moved around the sun in circular orbits and made the sun the center of the universe. Copernicus' thoughts are recorded in his works "De Revolutionibus Orbium Coelestium" and "Little Commentary." Johannes Kepler (d. 1630 A.D.) supported this idea in 1609 A.D. by stating that the sun is the center of the solar system and fixed the orbits of the planets into elliptical shapes through his three Kepler laws. Later, Galileo (d. 1642 AD) created a monumental telescope, and from his observations, he concluded that the Earth was not the center of movement. The discovery of this telescope, in addition to strengthening Copernicus' heliocentric concept, also opened a new chapter in the development of astronomy.

IV. Conclusion

Astronomy is a field of knowledge that studies celestial bodies and their environment. Around 4500 BC, it is considered the starting point of the emergence of knowledge, specifically astronomy and astrology, for subsequent civilizations. Babylonia, as a continuation of Sumerianism, had a very strong influence. Although astronomy and astrology interpret the universe, the two have significant differences. Ancient Egypt has a long history in science, inventing the sundial (mizwalah) and the calendar system of its time. Allegedly, the Ancient Chinese civilization also conducted studies on Nova and Supernova. These two civilizations played a special role in the emergence of Arab (Islamic) and Greek astronomical civilizations.

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The Direction of Sunset as a Reference for Determining the Qibla Direction (Study of Imam Al-Ghazali 's Views in the Book of *Ihya' Ulumuddin*)

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ABSTRACT

Qibla direction determination is an important aspect of Islamic worship. This research examines the method of determining the Qibla direction based on the direction of Sunset described in the book "Ihya Ulumuddin" by Imam Al-Ghazali. It evaluates the method's accuracy using literature and modern astronomical analyses, especially for the Thus region, where Imam Al-Ghazali lived. The results show that this method is taqribi, in which the direction of Sunset in the Thus region can be used as a Qibla reference for 213 days or 58% of a year, with a tolerance of 45 degrees of deviation.

I. Introduction

Qibla direction is one of the valid requirements that must be fulfilled before praying. A prayer is not valid if it is not facing the Qibla. Technically, facing the Qibla can be done in various ways with various objects that can be used as a reference to determine it. The most important thing is that when we talk about Qibla's direction, we are talking about direction, which is the closest direction to the Kaaba.[1]

Along with the development of the times, Qibla's direction was determined using modern tools such as theodolites and compasses. It also involves using technology such as GPS-based applications on smartphones and Global Positioning System (GPS) devices. The determination of Qibla direction in the early period only used miqyas or Istiwa stick, which is the determination of Qibla direction by utilising the shadow of the Sun before and after culmination on the Istiwa stick to determine the true west and east directions. Classical tools such as rubu' mujayyab were used to measure the angle of the Qibla direction after determining the true west and east directions.[2]

In addition to using miqyas or Istiwa sticks, the shadow of the Sun can also be used to determine the Qibla direction using the global Rashdul Qibla and local Rashdul Qibla methods. Global Qibla Rashdul is when the Sun is directly above Mecca, or Istiwa' A'dham. Global Rashdul Qibla is a natural phenomenon in which the Sun is directly above (zenith) the Ka'bah building, so the shadow that forms shows the direction of the Qibla. Local or daily Rashdul Qibla is a way of determining the Qibla direction using the daily position of the Sun on the path between our place and the city of Makkah. This method can be used daily but occurs at different times according to changes in its declination value and relative position to the observer's place.[3]

The Ministry of Religious Affairs has summarised the various methods of determining the Qibla direction in the pocketbook Hisab Rukyat. The book includes various traditional and modern methods to determine the Qibla direction accurately. It ranges from using simple tools such as miqyas and Istiwa sticks to using technology such as compasses and GPS. In addition, natural methods such as Rashdul Qibla are also explained in detail. This pocketbook is designed to provide an easy-to-understand and practical guide for people in determining the Qibla direction.[4]

If we look at studies on Qibla direction accuracy testing, it is often found that some mosques determine their Qibla direction by referring to the direction of the setting Sun. This method was often used especially in the past or in areas with limited access to modern technology. One such mosque is the At-Taqwa Lama Jampue Mosque, built in the 1700s. The Qibla direction is determined by looking at the position of the Sunset direction.[5] If examined further regarding the determination of the Qibla direction regarding the direction of Sunset in classical literature and books, it is found in the book Ihya Ulumuddin by Imam Al-Ghazali in which there is a discussion of how to determine the direction of the Qibla direction with the direction of Sunset.

In general, determining the Qibla direction with reference to the Sun is done when the Sun is still above the horizon. However, in Ihya Ulumuddin, Imam Al-Ghazali states that the Qibla direction can also be determined with reference to the direction of the Sun at Sunset. This approach provides a valuable alternative in situations where the conventional method when the Sun is above the horizon may not be applicable, thus expanding how Muslims can determine the Qibla direction under various conditions.

Ihya Ulumuddin is one of the great works written by Imam Al-Ghazali, a great Islamic scholar and philosopher from the 11th century. It discusses various aspects of Islamic life and teachings, including ethics, spirituality, and Islamic law. The work is highly regarded in the Islamic world and has become one of the classics in Islamic literature. In Indonesia, the existence of Ihya Ulumuddin is quite significant because it is one of the main references for Islamic scholars and scholars in understanding religious teachings and developing religious thought and there are still many Islamic boarding schools, Islamic educational institutions, and Islamic scientific development centres in Indonesia that use this book as one of the study materials.

From the above background, the author is interested in studying and analysing Imam Al-Ghazali's opinion on the direction of the setting Sun as a reference in determining the Qibla direction. The study to be carried out is to determine the accuracy of determining the Qibla direction using the direction of the Sun as a guide. In addition, the author is also interested in examining the relevance of the practice of determining the Qibla direction using the direction of Sunset as Imam Al-Ghazali's opinion in the book of Ihya Ulumuddin because the direction of Sunset is not static. The Sun does not always set in the same place every day, this phenomenon is related to changes in the Sun's declination value.

II. Method

This research is an in-depth literature research. The main focus of the research is to examine Imam Al-Ghazali's explanation in the monumental book Ihya' Ulumuddin, especially regarding the method of determining the Qibla direction by relying on the direction of the setting of the Sun. This research will analyse the accuracy of the method from the point of view of modern astronomy. In the first step, the researcher will calculate the Qibla azimuth value for the Thus region by using this place because that is where Imam Ghazali lived. Since the declination value of the Sun changes throughout the year, we will also calculate the azimuth of the Sun at Sunset in the Thus region for the whole year. This aims to evaluate the relevance and accuracy of the traditional method used by Imam Ghazali in the context of astronomy today.

III. Result dan Discussion

A. Qibla Direction Determination in Kitab Ihya Ulumuddin

I. Kitab Ihya' Ulumuddin and Imam Al-Ghazali

The Ulama who has the name Abu Hamid Muhammad Ibn Muhammad Ibn Muhammad Al-Ghazali Al-Thusi. He was born in 1058 AD or 450 H in the Ghazalah area, located in the city of Thus and is a suburb of the Khurasan region which we now know as Iran. In addition, some say that he was born in a small village near Thus in Kurasan, which at that time was the centre of science and the territory of Baghdad under the Saljuk dynasty. He died in Thusia, where he was born, on Monday, 18 December 1111 M, or 14 Jumadil Akhir 505 AH.[6]

He was one of the foremost Islamic thinkers who was given the title *Hujjatul Islam* which means proof of the truth of Islam. This reflects the recognition of Al-Ghazali's pivotal role in articulating and strengthening Islam's intellectual and spiritual foundation in his day. In addition, Imam Al-Ghazali was also given the title *zain ad-din* which means jeweller of religion. This title was given to him because of his great contribution to the understanding and developing Islamic theology, philosophy, and Sufism.[7] Al-Ghazali's father was a poor, devout woollen spinner who favoured scholars and actively attended recitation assemblies.[8]

Al-Ghazali lived in the Levant for ten years, moving back and forth between Damascus, Baitul Maqdis, and Hijaz. As a result of a long process of evaluating his thoughts, beliefs, and soul, he finally considered finding the truth he was looking for. The book Ihya' Ulumuddin, Al Ghazali's monumental work, was created during his journey of thought, belief, and soul in the Levant. Al Ghazali later taught it in Baghdad."[9] The book of Ihya ulumuddin, written by Imam Al-Ghazali, focuses on the treasures of Sufism. Moreover, according to Imam Al-

Ghazali, "not only is knowledge to be understood, it is also required to be practised or put into practice." Therefore, this book serves as a bridge that connects sharia with Sufism.

The book of ihya ulumuddin includes four main discussions (*rubu')*. The first *Rubu' Ibadah* covers the science and principles of creed, as well as the procedures for purification, prayer, zakat, fasting, hajj, the manners of reading the Qur'an, dhikr and prayer, wirid and the timing of its implementation. *Rubu' 'Adah* discusses the etiquette of eating and drinking, marriage, work, halal and haram, and associating and making friends, uzlah, travelling, and amar ma'ruf nahi munkar. *Rubu' Muhlikat* deals with matters relating to the heart, including an explanation of the greatness of the heart, the training of the soul, the dangers of lust of the stomach and private parts, the dangers of the tongue, anger, envy, and spite, as well as the dangers of the world, wealth, avarice, pride, riya, and the dangers of speaking unwholesome things. *Rubu' Munjiyat* discusses the actions that must be taken by a servant to purify himself to always be close to Allah SWT, including repentance, patience, gratitude, fear of Allah, always hoping in Him, zuhud, tawakkal, honesty, sincerity, muhasabah, self-reflection, and remembering death.[10]

II. Determination of Qibla Direction with Reference to the Sunset Direction in Kitab Ihya 'Ulumuddin

Fiqh scholars classify several existing Qibla references with the term adillah al-qiblat. Some of these Qibla references are lailiyyah (applicable at night) and some are nahariyyah (applicable during the day). When viewed from its location, the Qibla reference is located on Earth (*ardhiyyah*), air (*hawaiyyah*) and the sky (*samawiyyah*).[11]

In the book of Ihya 'Ulumuddin, the Qibla issue is included in *rub'u al-'adah,* specifically in discussing the manners of people who want to travel *(musafir).* For someone who wants to travel or *musafir*, it is appropriate to know and master the knowledge to determine the Qibla direction so that they can still pray in the middle of their journey. Imam Al-Ghazali then explained that the Sun is the Qibla reference in the sky. When the Sun sets, the direction of the setting Sun can be used as a reference to determine the Qibla direction. This is what he said in the book Ihya 'Ulumuddin[12]:

وأما القبلة وقت المغرب فإنها تدرك بموضع الغروب

> "As for the Qibla direction at maghrib time, it can be found by looking at the position of the setting Sun."

The Sun as a reference in determining the Qibla direction by Imam Al-Ghazali is said to be as if its position indicates the direction of the Qibla for the 5 daily prayers. This is according to him as he said

فكأن الشمس تدل على القبلة في الصلوات الخمس
"It isas if the Sun indicates the Qibla direction in the five daily prayers".[12]

B. Astronomical Analysis in Determining Qibla Direction in Thus City with Reference to Sunset Direction

In an astronomical context, the Qibla is the closest direction to the Ka'bah.[13]When depicted on a spherical plane by forming a spherical triangle, the Qibla direction is the direction of one of the great circles in the spherical triangle that connects a city to the Ka'bah. The coordinate system used is the Horizon coordinate system. The Horizon coordinate system is more appropriate because it relates directly to the observer's position on the Earth's surface, where the Qibla direction is the horizontal direction from the observer's position towards the Ka'bah in Mecca. This means that to know the Qibla direction, it is necessary to know the latitude of the place, the longitude of the place, the latitude of the Ka'bah and the longitude of the Ka'bah as shown in Figure 1.

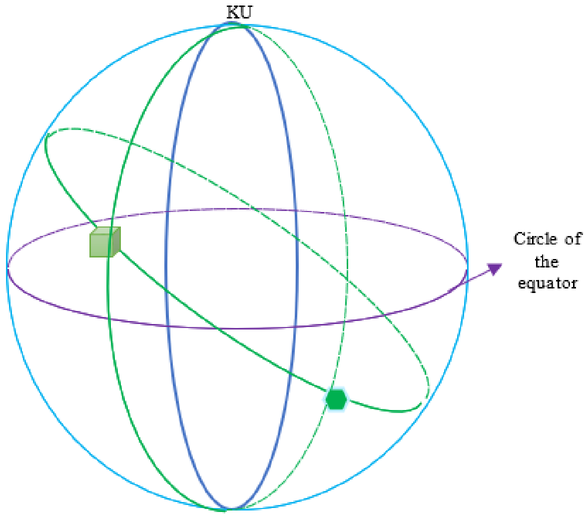

Figure 1. Qibla Direction on the Earth's Surface from a Specific Location

From this description, the formula for determining the Qibla value of an area is obtained is shown in (1):

(1.) Tan AQ = Tan LK * Cos LT / Sin SB - Sin LT / Tan SB

Where:
AQ: Qibla Direction
LK: Latitude of the Kaaba
BK: Longitude of the Kaaba
LT : Latitude of Place
BT : Longitude of Place
SB : Longitude Difference

So, to determine whether a celestial body is appropriate to be used in the Qibla direction, one must see whether the position of the celestial body is in the direction or azimuth of the Qibla. In this context, as an analysis of the Qibla concept in Thus City with reference to the position of the setting Sun can be seen as follows:

I. Thus City

Thus, or Tus, is a historical city currently located in the Razavi province of Khorasan in northeastern Iran. The city has a long and rich history, dating back to ancient times and is famous as the birthplace of several important figures in Iranian history and culture, one of whom is Imam Al-Ghazali as shown in Figure 2.

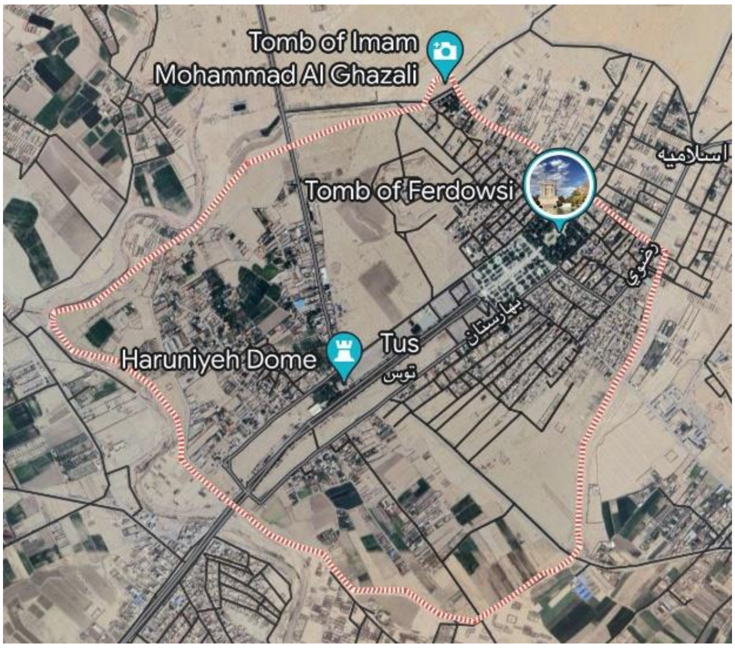

Figure 2. location of Thus city seen from google earth

II. Geographical Condition and Qibla Direction of Thus City

The city of Thus, which is now part of the Khurasan Rezavi province in Iran, has an interesting neighbourhood. Thus is located about 24 Km east of Mashad, the capital of the province, and is surrounded by lowlands and hills. In addition, many deserts border this area. Thus has a semi-desert climate, with hot and dry summers and cold and slightly rainy winters. In summer, temperatures can reach over 40 degrees Celsius; in winter, temperatures can drop to freezing. The Kashaf River that runs through the city is essential for providing water for the surrounding farms. Thus, natural resources, including copper mines and other mineral deposits, are very rich. Agriculture is very important in the region, especially in the fertile lowlands. Thus, Iran's strategic city has a diverse geographical environment and important natural resource potential. Thus, the city is astronomically located at Latitude 36° 28'35.47" LU and 59° 30' 11.19" East, with an altitude of 998 Metres.

To calculate the Qibla direction of the city of Thus, we need the following data:

The latitude of the place (φ^x) : 36°28'35.47"
Longitude of the place (λ^x) : 59°30'11.19"
Latitude of Makkah (φ^m) : 21°25'21,17"
Longitude of Makkah (λ^m) : 39°49'34,56"
Longitude Difference of Makkah-Region (SBMD)
SB = $\lambda^x - \lambda^m$
SB = 59°30'11.19" – 39°49'34.56"
SB = 19°40'36.63"

Calculation of Qibla azimuth is shown in (2):

(2) Tan AQ = Tan LK * Cos LT / Sin SB - Sin LT / Tan SB

Tan Q = Tan 21°25'21.17"x Cos 36°28'35.47" / Sin 19°40'36.63"- Sin 36°28'35.47"/Tan 19°40'36.63"

AQ = -35° 57' 40.68"

Qibla azimuths are:

West – North : -35° 57' 40,68"
North – West : 125° 57' 40,68"
North - East - South – West : 234° 2' 19,32"

Based on the results of the above calculations, the results of the calculation of the Qibla azimuth for Thusi City carried out by the researcher show the results with a value of **234° 2' 19.32"** NESW as shown in Figure 3.

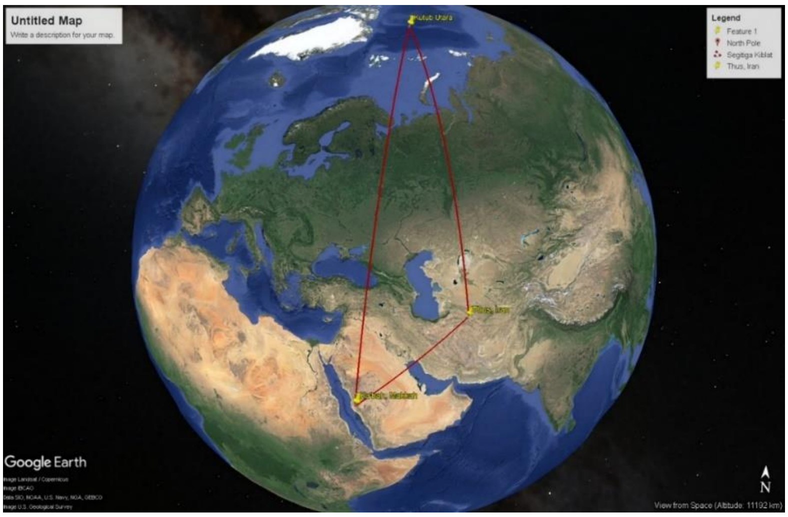

Figure 3. The location of Thus City seen from Google Earth

C. Sun's Azimut at Sunset

Azimut is the angle formed between a point from north, calculated clockwise with a range of 0° -360°. The azimuth between two points is the angle formed from a clockwise reference to the line connecting the two points. North has an azimuth of 0°, east 90°, south 180°, and west 270°. When someone points a compass at a particular object and measures the angle between that object and north, that angle is called the azimuth. Azimut is one method used to determine an object's direction or position. To determine the azimuth, we must know the true cardinal directions first. This cardinal direction can also be used as a reference for the Qibla azimuth, so that the observer can use the reference as a reference as shown in Figure 4.[14]

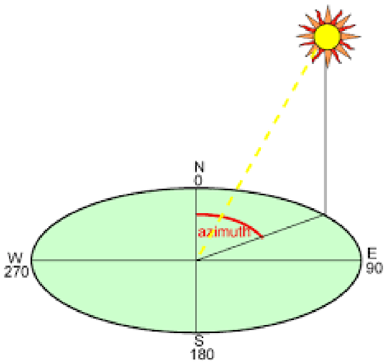

Figure 4. azimuth illustration

Every day, the position of the Sunset astronomically changes from day to day due to the tilt of the Earth's axis. The rotational motion of the Earth and its orbit around the Sun determine the position of Sunset each day. The position of the setting Sun is always different every day due to the Earth's rotational motion on its axis and the Earth's journey around the Sun in its orbit. As the Earth rotates, the relative positions between the Earth, the Sun and the observer are constantly changing, causing the point of Sunset to appear to shift each day. Earth's rotational movement and its orbit create a continuous change in the angle of Sunset that, if observed daily, creates a diverse sky panorama. The azimuth in this figure is the value measured along the horizon circle from true north to the point where the celestial body passes, as shown in Figure 5.

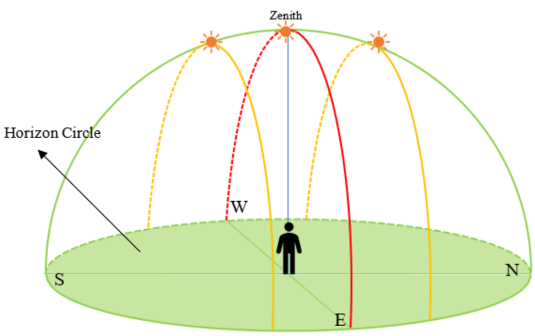

Figure 5. Illustration of the changing position of the rising and setting Sun

D. Declination Of The Sun

Declination is the distance of a celestial body to the celestial equator measured through the circle of time to the celestial pole. In other words, declination is the mail or inclination of a celestial body from the celestial equator. North of the equator, declination is signalled(+) and is positive; south of it, declination is signalled(-) and is negative. In astronomy, declination is characterised by the Greek letter "delta" (δ).[15]

Meanwhile, the declination of the Sun is defined as the celestial latitude of the Sun at the time in question. It is the angle in the sky measured from the celestial equator's plane, indicating the Sun's north or south position at any given moment. With a value of 0° when on the celestial equator, the celestial latitude ranges between -23.5° when on the southern solstice and +23.5° when on the northern solstice. Due to the inclination of the Earth's axis with respect to the plane of the ecliptic, this declination changes periodically throughout the year. When the Sun passes the solstice, declination reaches a maximum, and when the Sun crosses the celestial equator, declination is 0° as shown in Figure 6.

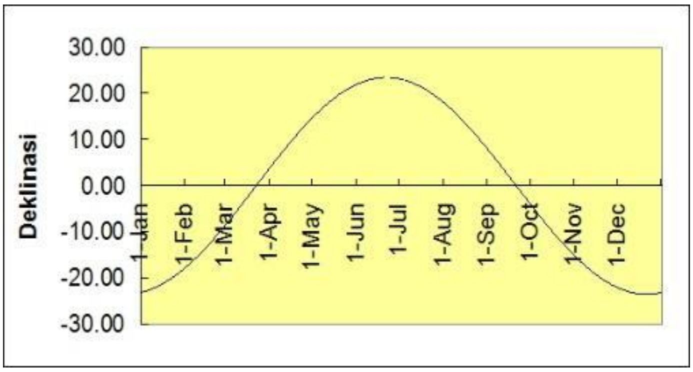

Figure 6. Variation in solar declination

The Sun's decline changes throughout the year, but on any given date, the Sun's decline is almost the same. Between 21 March and 23 September, the declination is positive (+); from 23 September to 21 March, the declination is negative(-). After 21 March, the Sun gradually moves northwards from the equator and further away from the equator. On 22 June, the Sun reaches its farthest point north by 23.5°. Then, gradually, the Sun turned towards the equator, getting closer to the equator, and on 23 September, the Sun was again right on the equator. Since then, the Sun has continued to move southwards and on 22 December, the Sun is further away from the equator, as far as 23.5° South. Then, it turns around and gets gradually closer to the equator until it is exactly on the equator on 21 March as shown in Figure 7.[15]

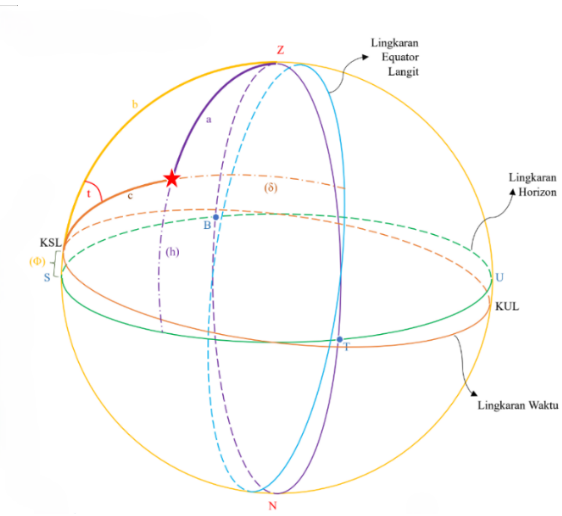

Figure 7. Depiction of the Sun's declination (δ) on the celestial sphere from a position of latitude -7 degrees.

This declination variable greatly affects changes in the Sun's azimuth, which is the horizontal angle between true north and the Sun's projected position on the horizon. Changes in declination cause daily variations in the Sun's rising and setting positions, which affect its azimuthal value. This understanding is important in astronomy and various applications that require knowledge of the Sun's position in the sky. If we observe how the Sun's declination changes over the course of a year, we can see how the Sun's azimuth changes. Based on the Earth's elliptical revolutionary trajectory and its tilt to the axis of rotation of 23 degrees 27 minutes, this causes a phenomenon called the "Analemma", the Analemma is the position of the Sun on its trajectory as seen from Earth over the course of a year at the same time and location. The position of the Sun when combined in a diagram will form a pattern resembling the number 8. The Analemma serves to determine the location with three coordinate variables, namely the Sun's declination, latitude, and hour as shown in Figure 8.[16]

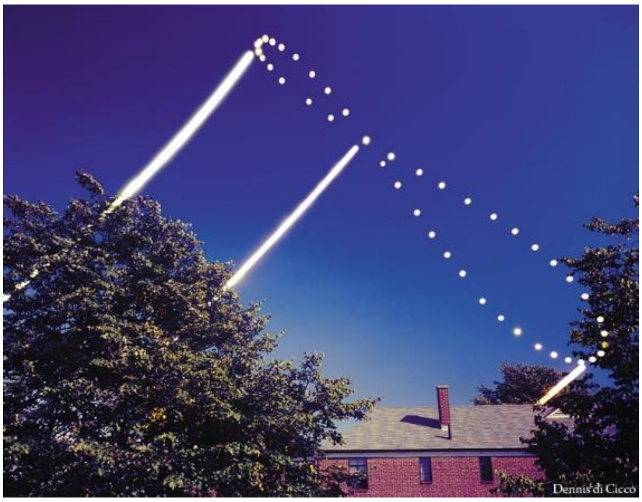

Figure 8. Photograph of Annalemma taken by Dannis di Cicco[17]

E. Relevance of Qibla Direction Determination Using Sunset Direction in Kitab Ihya Ulumuddin

Using the Sun as a reference in determining the Qibla direction can be done by paying attention to several things if you want to get accurate results. In determining the Qibla direction using the setting direction of the Sun, we must pay attention to the Sun's declination times that correspond to the Qibla azimuth at the time of Sunset. By calculating the declination of the Sun, then using it to determine the position of the setting Sun, we can find out when the Sun sets according to the Qibla azimuth of the place of observation. This should be noted because using the setting direction of the Sun in determining the Qibla direction cannot be done every day because the place where the Sun sets always changes every day depending on the value of the Sun's declination as shown in Figure 9.

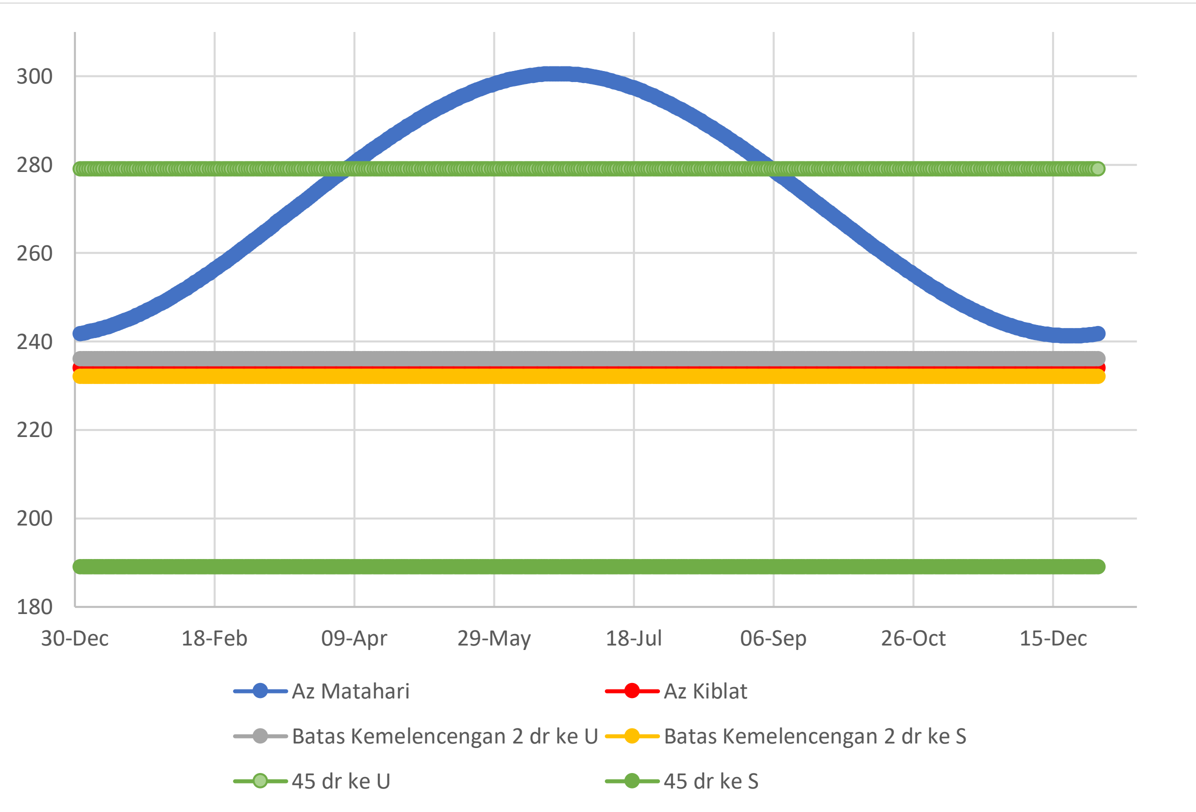

Figure 9. Changes in the Azimut of Sunset to Qibla Azimut of Tus City

In the case of Qibla direction in the city of Thus, after calculating the declination of the Sun for one year in 2024. In this way, we can find out potentially when the setting direction of the Sun corresponds to the Qibla direction in the region of Thus. From the graph above, the red line shows the Qibla direction, the yellow and grey lines show the tolerance limit of 2 degrees to the right and left, the green line shows the corridor limit of "*jihah qiblah*" (45 degrees) and the blue graph shows the change in the azimuth value of the Sun at Sunset in the Thus region for 1 year

In 1 year, the azimuth value of the Sun at Sunset fluctuates, ranging from 241° 11' 54.87'' to 300° 30' 14.25''. While the value of Qibla azimuth for Thus region is ^{2340} 2' 19.32''. This means that the position of the Sun at Sunset in the region of Thus is never precisely at the Qibla azimuth. Its closest position to the Qibla azimuth is still 07° 09' 35.55''. The furthest distance from the qibla azimuth reaches 59° 18' 19.38''. This means that it has exceeded the limit of the *jiha* corridor (45 degrees) so that it can no longer be used as a reference at certain times. This condition can occur between 07 April and 05 September if examined further. The difference in the Sun's azimuth value from the Qibla azimuth exceeds 45 degrees, which means that in that date range, the position of the setting Sun cannot be used as a reference for determining the Qibla. The position of the setting Sun can be used as a reference only when the value is outside these dates. This phenomenon, if pro-rated, will result in the following data In 365 days, only 213 days or equivalent to 58% of the position of the setting of the Sun can be used as a reference for determining the Qibla, because the difference in azimuth is less than 45 degrees. The rest (42%) cannot be used as a reference because the difference exceeds 45 degrees, as shown in Figure 10.

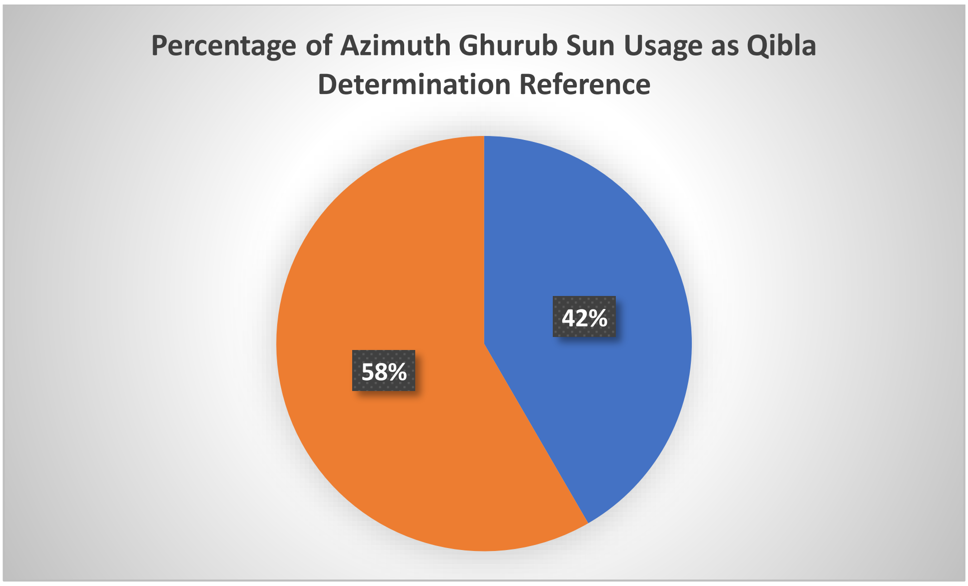

Figure 10. Percentage of Azimuth Ghurub Sun Usage as Qibla Determination Reference

Using the position of the setting Sun as a reference in determining the Qibla direction in a place is an accurate method as long as we know the times when the position of the setting Sun corresponds to the Qibla direction. By knowing the declination of the Sun, we can know the time when the Sun sets following the Qibla direction of a place. This method of determining the Qibla direction regarding the direction of Sunset for Thus city is a taqhribi or approximate method of determining the Qibla direction because the results do not get an exact value but have a variable value of difference.

IV. Conclusion

From the above explanation, it can be concluded that the method of determining the Qibla direction by using the reference of the position of the setting of the Sun in the Thus region as mentioned in the book of Ihya' Ulumiddin is taqribi, there is no position of the Sun that is exactly the azimuth value in accordance with the value of the Qibla azimuth in Thus for 1 year. Nevertheless, for the context of qibla jiha 'ah that tolerates a 45-degree deviation, within a span of 1 year the phenomenon of the setting of the Sun can be used as a reference for determining the Qibla in the Thus region for 213 days or 58%, namely other than in the span of 07 April to 05 September.

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The Global Islamic Calendar According to Syamsul Anwar's Thoughts

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ABSTRACT

From the past until now, Muslims have not had a single calendar, which has resulted in differences in determining Muslim holidays. The absence of an Islamic calendar globally will create chaos in the organization of time in the world, both times of worship (religion) and social activities (muamalah). This article uses the figure of Syamsul Anwar as a figure driving the global Islamic calendar in Indonesia to overcome differences in determining Muslim holidays and reveals how to understand the concept offered. This study explores his thoughts using works (books, journals, and other sources of information). The methodology in this research is library research, where the primary data source is obtained from the study of books related to this research problem, both through primary and secondary data sources. Syamsul Anwar offers several concepts or principles so that a global Islamic calendar of one day and one date throughout the world can be realized. His principles were total acceptance of reckoning, transfer of imkanur rukyat, having one matlak, and agreeing to the international date line. The global Islamic calendar will soon be achieved by agreeing to this principle.

I. Introduction

The Global Islamic Calendar is an Islamic calendar with the principle of one day and one Hijri date worldwide [1]. This means that if in Indonesia Eid al-Adha 10 Dzulhijjah 1444 H falls on Wednesday, 28 June 2023, then it also applies to all regions on Earth. The Global Islamic Calendar carries several main principles, namely the acceptance of imkanur rukyat, absolute unity, one day and one date around the world, the use of international datelines, and the use of the Islamic calendar for worship and muamalah matters [2].

According to Syamsul, there are two main categories in the Global Islamic Calendar: the single global calendar and the zonal global calendar [3]. Unifying the Global Islamic Calendar is an essential step in answering the demands of globalization and understanding geographical differences in carrying out Islamic worship.

The main challenge in implementing the Global Islamic Calendar is that many Muslims, including astrologers and Sharia experts, have not fully understood the concept, its usefulness, and its urgency [4]. Most of the discussion still revolves around the debate between the rukyat and Hisab methods in determining the beginning of the month in the Islamic calendar.

The importance of the idea of the Global Islamic Calendar is supported by several reasons, one of which is Arafah Day is the absence of the Global Islamic Calendar in determining the time of worship worldwide, so the Arafah fast often falls on a different day from the waqf day of hujjaj in Mecca. The fall of the 9th of Dzulhijjah in some parts of the world, especially in Islamic countries, is often not the same as the 9th of Dzulhijjah in the holy land [5].

In addition to Arafah Day, the Global Islamic Calendar is needed so that Muslims worldwide can carry out religious celebrations in unison to welcome important moments such as Eid al-Fitr, Eid al-Adha, and Ramadan Fasting. The presence of the Global Islamic Calendar will further strengthen Islam as a united ummah

II. Method

The methodology in this study is literature research, in which the primary data source is obtained from the study of books related to this research problem, both through primary and secondary data sources.

III. Results and Discussion

In Indonesia, one of the figures who support the existence of a unificative calendar and provide a concept to realize the formation of an Islamic calendar globally is Prof. Dr. Syamsul Anwar, MA [6]. He was the chairman of the Tarjih and Tajdid Council of Muhammadiyah Central Committee from 2005-2010 and 2010-2015; his thoughts related to the global Islamic calendar are very progressive and have the power to explore the future [5]. He is known as a figure in Indonesia's global Islamic calendar development. His ideas about the calendar surpassed the Falak figures in Indonesia. His most phenomenal idea regarding the calendar is the concept of a "unification Islamic calendar" (at-Taqwim al-Qamary al- Muwahhad), which is being conceptualized and promoted. The unification Islamic calendar is a calendar with the principle of one day and one date worldwide. The concept aims to enable Muslims to hold religious celebrations simultaneously around the world, such as starting fasting and holidays [3]. The unificative calendar is a concept with the principle of one day, one date worldwide, and the benchmark conjunction is GMT. The concept of Syamsul Anwar's calendar is the result of the development and elaboration of the calendar concept made by Jamaluddin 'Abd ar-Raziq. A global calendar will be carried out with certainty if prepared using hisab. Because only with hisab can scheduling be done reliably far ahead. In classical or ancient times, calendars were used to organize time naturally. Meanwhile, the calendar in modern times is an effort to organize time as a guideline, sign, and rule for humans to carry out their daily activities all the time.

In Islamic law, the times to carry out specific worship based on the month of qamariah, such as the mandatory fasting in the month of Ramadan, the Eid al-Fitr prayer on the first day of Shawwal, and the Eid al-Adha prayer on the tenth day of Dzulhijjah and other worship related to the time of the calendar. Thus, the use of the calendar in a unificative manner is very much needed by Muslims.

The Concept of the Global Islamic Calendar According to Syamsul Anwar

Regarding the Principles that underlie the Global Islamic Calendar, there are several requirements, namely: 1. Receipt of hisab 2. Transfer imkan rukyat 3. Absolute unity 4. Conventional day acceptance or alignment of days and dates, and 5. International date line acceptance.

1) Hisab Receipt

Because the calendar is a calendar system that determines the period far into the future, it is the same as other calendar system systems, and the Global Islamic calendar requires the use of the hisab system (counting) and the traditional system Buman in the form of rukyat (observation of the naked eye),

The difficulty of accepting the ummah to the Global Islamic Calendar is due to the lack of understanding of the hisab system. Most Muslims consider determining the date through the rukyat method Islamic because it follows the sunnah of the Prophet Muhammad SAW. In contrast, the hisab method is not Islamic because it has never been exemplified by the Prophet Muhammad SAW.

2) Imkan Rukyat Transfer

Imkan Rukyat is a theory that requires certain parameters to be considered a hilal, and it is possible to see or observe it after sunset. Simply put, Imkan Rukyat is the possibility of the naked eye to become a hilal sikah. The reason is that Imkan Rukyat, at the time of the first riabilitas, only covered part of the Earth. While a part of the world has Imkan Rukyat, other regions have not experienced it; even in that place, the moon is still below the horizon. This circumstance requires the principle of imkan rukyat transfer.

For example, as in the case of the transfer of imkan rukyat above, if the hilal has been seen in the western part of the Earth or the city of Istanbul, for example, then the eastern region that has not seen the hilal due to natural impossibility such as Jakarta is required to follow the results of the rukyat of Istanbul and not even postpone the determination of the Hijri date until the hilal is involved in the city of Jakarta

3) Matlak Unity

The principle of the Unity of Matlak (the area where the sun rises, the dawn rises, or the moon rises) is a consequence of the principle of imkan rukyat transfer, which means that the entire Earth is seen as one matlak. Therefore, if there has been imkan rukyat somewhere on the Earth, then it is also seen as applicable to the entire area of the Earth because the entire Earth is a single matlak.

4) Conventional Day Acceptance or Day and Date Alignment

The conventional day acceptance referred to here is an agreement related to the change of day. If usually the change of days in the Hijri calendar is marked by the setting of the sun, then following the conventional method, the change of day is marked by a time measure, namely 24.00 or 00.00

5) International Date Line Acceptance

The Global Islamic Calendar is a calendar based on the principle that days and dates are aligned throughout the world, meaning the same as the function of the Christian calendar: one day in a week is marked by one date. If the 11th of Muharram falls on Sunday in one place, then in any other part of the world, the 11th of Muharram also falls on Sunday. There is no dualism or difference in the days of Hijri between one country and another.

The International Date Line is an imaginary demarcation line on the Earth's surface that stretches from the north pole to the south pole and limits the change from one calendar day to the next. This line passes through the middle of the Pacific Ocean, following the 180-degree longitude, which is the beginning of the new day.

The arguments that can be put forward against the need for the existence of the Global Islamic Calendar include. In Q.S Al Baqarah (02) verse 189, there is a condition that the time system in Islam must be integrated, including civil aspects and worship aspects. The civil aspect is marked by the quota "innas" (For humans). This sentence is general because it distinguishes tribes, nations, cultures, and languages. The aspect of worship is marked by the word "wal hajj" (And this worship).

Previous scholars' interpolation on the Prophet SAW hadiths has also been translated globally. Among others, a scholar in the shafi'i madhhab named Al-imam an-Nawawi (W.676 H I 1277 AD) in his work "syarh shahib muslim" Hikay the opinion of a number of his colleagues that Rukyat (involvement of the hilal) in a place is applied comprehensively in various parts of the world (ta'umm ar - ruyah fi maudhi'ami' ahl ar - radh) [7]. Furthermore, Shaykh Zadah in "majma' al-Anhar " states that when the hilal is seen somewhere, its involvement applies to all human beings. In this case, there is no difference between matlak. For example, when the Ramadan hilal is seen in the western hemisphere, it also applies to the eastern hemisphere. At the same time, Ibn Nujain al-mishry (d. 971 H I 1564 AD) states that there is no difference in matlak at all, so if the hilal is seen in a country (where other countries are not visible), then the involvement applies (mandatory) to other regions [8]. They are obliged to fast with the rukyat. Here, it appears that the visibility of the hilal (rukyat) for the Western population applies to that of the Eastern population.

Strategy for Realizing the Global Islamic Calendar

The strategies used are: 1) Syamsul Anwar emphasized the importance of socializing and disseminating information about KHGT, its urgency and benefits, reasons why it should be used, and the basics of its application. Socialization can be done through various modern means of communication [5]. 2) Syamsul Anwar highlighted the need to educate the species of astrologers and sharia experts who will become the guardians of KHGT. They can conduct studies and research, prepare calendars, and develop calendars and astronomy. Observatory owned by Muhammadiyah, such as those at UMSU Medan and UAD Yogyakarta [9]. 3) Intensify scientific publications on calendar issues through national and international journals. With wider scientific publications, knowledge of calendar issues can be expanded and accessed by scientists and practitioners worldwide. 4) Syamsul Anwar stated the importance of training missionaries and leaders of the Tarjih and Tajdid Council at various levels to understand KHGT well [10]. They are key figures in conveying the message about KHGT to Muslims. Missionary training is crucial to ensure effective socialization. 5) The fifth strategy involves establishing communication with the Saudi Arabian side to discuss the need for a Global Islamic Calendar and explain the uncertainty of the absence of the KHGT.

Saudi Arabia has a central role in implementing the KHGT because the wukuf event in Arafah, which is one of the keys to the unification of the calendar, occurs in their territory [11]. With these strategies, it is hoped that efforts to realize the Single Global Hijri Calendar (KHGT) will be more targeted and succeed in uniting the calendar and worship of Muslims worldwide. The Tarjih and Tajdid Council of Muhammadiyah Central Committee hopes that the uniformity of the calendar will increase understanding and unity in carrying out religious services worldwide.

IV. Conclusion

This study concludes that Syamsul Anwar's understanding of the global unification of the Islamic calendar is Syamsul Anwar's urgent hope for the realization of fasting and holidays that can be carried out together worldwide. The unity of Muslims around the world is not impossible if Muslims around the world both want a unification calendar.

Syamsul Anwar's thoughts and ideas deserve appreciation even though there has been no breakthrough in realizing them. It is necessary to hold regular meetings with various experts to realize the calendar, such as astronomy experts, astronomers, jurists, and other Islamic science experts who can support the formation of a global Islamic calendar.

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Determination of Prayer Time Schedule According to Abd. Jalil Manaf Husaini

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ABSTRACT

Abd. Jalil Manaf Husaini is compiling a prayer time schedule for all time, examining and seeing the sun's shadow using a walking stick. Determination of the schedule prepared by Abd. Jalil Manaf Husaini, are there differences and similarities with the eternal prayer schedule published by the government. This research analyzes the universal Prayer Time Schedule according to Abd. Jalil Manaf Husaini.

The method used to study this is library research with three approaches, namely, the sharia approach, which is carried out through Islamic law, using verses of the Qur'an and hadiths as the main legal basis. Meanwhile, the secondary materials are books related to research. The content method analysis was later used after being concluded and arranged in a clear framework. The results of this research are the basis for determining eternal prayer time schedules, according to Abd. Jalil Manaf Husaini is the end of verse 103. From this research, the author concludes that the difference is slower, up to one or two minutes, which is extra time or Ihtiathi Abd. Jalil Manaf Husaini. Meanwhile, the eternal prayer time schedule published by the Government (BHR Riau Province) does not yet include Ihtiathi times.

I. Introduction

Humans are beings created by Allah SWT, endowed with perfection that surpasses all His other creations. This perfection comes with the significant responsibility of upholding trust and continually serving Him. Salah (prayer) is one of the five pillars of Islam, making it a core component of a Muslim's daily worship. Each prayer is performed at specific times corresponding to the sun's natural movement across the sky. These prayer times vary depending on the geographical location, season, and even the specific method used for calculation. Allah SWT has created humans to worship and serve Him, as stated in Surah Adz-Dzariyat, verse 56:

وَمَا خَلَقْتُ الْجِنَّ وَالْاِنْسَ اِلَّا لِيَعْبُدُوْنِ

Meaning: And I did not create jinn and man but for them to serve Me [1].

One of the ways that Allah SWT has determined humans to devote themselves to Him is through prayer. According to sh'i, prayer is an obligation imposed on humans who were regulated at its implementation, so it is included in muwaqqat worship [2]. Although the time of its implementation is not clearly explained, the sharia of the Qur'an has determined it, as explained in Surah Al-Nisa verse 103 which reads :

فَاِذَا قَضَيْتُمُ الصَّلٰوةَ فَاذْكُرُوا اللّٰهَ قِيَامًا وَّقُعُوْدًا وَّعَلٰى جُنُوْبِكُمْ ۚ فَاِذَا اطْمَأْنَنْتُمْ فَاَقِيْمُوا الصَّلٰوةَ ۚ اِنَّ الصَّلٰوةَ كَانَتْ عَلَى الْمُؤْمِنِيْنَ كِتٰبًا مَّوْقُوْتًا

Meaning: So when you have completed (your prayer), remember Allah when standing, sitting and lying down. Then when you feel safe, then establish the prayer (as usual). Indeed, prayer is obligatory that is determined for the believers. The explanation of prayer times is also contained in Surah Al-Isra' verse 78 which reads:

اَقِمِ الصَّلٰوةَ لِدُلُوْكِ الشَّمْسِ اِلٰى غَسَقِ الَّيْلِ وَقُرْاٰنَ الْفَجْرِ ۗ اِنَّ قُرْاٰنَ الْفَجْرِ كَانَ مَشْهُوْدًا

Meaning: Establish prayer from after the sun goes down until dark at night and (also establish prayer) at dawn. Indeed, the dawn prayer was witnessed (by an angel).

Also in the hadith of the Prophet Saw., it is explained about the times of obligatory prayer or maktubah contained in the book Syarh Subulus Salam Matan Bulughul Maram by Muhammad bin Isma'il Al-Shan'ani which reads below:

عَنْ عَبْدِ اللَّهِ بْنِ عَمْرٍو رَضِيَ اللَّهُ عَنْهُمَا; أَنَّ نَبِيَّ اللَّهِ - صلى الله عليه وسلم - قَالَ: - وَقْتُ الظُّهْرِ إِذَا زَالَتْ الشَّمْسُ, وَكَانَ ظِلُّ الرَّجُلِ كَطُولِهِ مَا لَمْ يَحْضُرْ الْعَصْرُ, وَوَقْتُ الْعَصْرِ مَا لَمْ تَصْفَرَّ الشَّمْسُ, وَوَقْتُ صَلَاةِ الْمَغْرِبِ مَا لَمْ يَغِبْ الشَّفَقُ, وَوَقْتُ صَلَاةِ الْعِشَاءِ إِلَى نِصْفِ اللَّيْلِ الْأَوْسَطِ, وَوَقْتُ صَلَاةِ الصُّبْحِ مِنْ طُلُوعِ الْفَجْرِ مَا لَمْ تَطْلُعْ الشَّمْسُ - رَوَاهُ مُسْلِمٌ.[4]

Meaning: From Abdullah bin Umar RA. The Prophet Muhammad said, the time of zuhur, when the sun slips until the shadow is equal to the length of his body before entering the time of asr, the time of asr continues (since the shadow of a person is equal to the length of his body as long as the sun has not turned yellow, the time of Maghrib continues as long as the shafaq (red cloud) has not disappeared, the time of isha until midnight and the time of dawn begins since the dawn of shodik as long as the sun has not yet risen. (HR. Muslim). The time of zuhur is when the sun moves from the meridians4, the axis of the shadow turns to the east, and the angle it makes with the I'tidal line is no longer 900. The sun is said to have slipped, and the beginning of time has entered; when the centre point of the sun slips from the meridians, one is not allowed to pray, and if after the centre point of the sun is detached from the meridian line, the sun has slipped to the west and the time of zuhur has entered. [3]

II. Method

The type of research used by the author in his research is library research which provides a systematic, normative, organized, and accurate explanation of the subject matter of the problem using valid data. The research approach in this journal includes three approaches, namely, the sharia approach, which is carried out through Islamic law, using verses of the Qur'an and hadiths as the main legal basis. The astronomical approach is used to study the object of research in depth. The sociological approach is in the form of interviews both in person and online to get the information needed.

The data sources in this study follow the classification method used in library research, so it is clear that the data needed are obtained through research on secondary scientific books. Where secondary data is data obtained by researchers from existing sources.

III. Results and Discussion

The five daily prayers are *Fajr*, *Dhuhr*, *Asr*, *Maghrib*, and *Isha*. The time for each prayer is based on a combination of visual observation and precise astronomical calculations. With the advent of modern technology, these times are now available through apps, websites, and digital clocks, allowing Muslims to determine the correct times for prayer regardless of location easily.

1. **Fajr (Dawn Prayer):** *Fajr* is performed before sunrise, marking the beginning of the day for Muslims. The time for *Fajr* begins when the first light appears on the horizon, which is known as the "true dawn" or *Fajr Sadiq*. The prayer must be completed before the sun rises.
2. **Dhuhr (Midday Prayer):** The time for *Dhuhr* begins when the sun has passed its zenith and starts to decline, marking the middle of the day. It is typically observed just after noon, and the prayer window lasts until the shadow of an object is equal to its length.
3. **Asr (Afternoon Prayer):** *Asr* time begins when the shadow of an object is twice its length, marking the later part of the afternoon. This prayer can be performed until just before sunset, although praying earlier in the time window is recommended.

4. **Maghrib (Sunset Prayer):** *Maghrib* is performed immediately after sunset. The window for this prayer is relatively short, beginning just after the sun has set and lasting until the red twilight disappears from the sky.
5. **Isha (Night Prayer):** The *Isha* prayer is performed after the twilight has completely faded, signaling the onset of night. This prayer can be performed until the middle of the night, with some schools of thought extending the time until dawn.

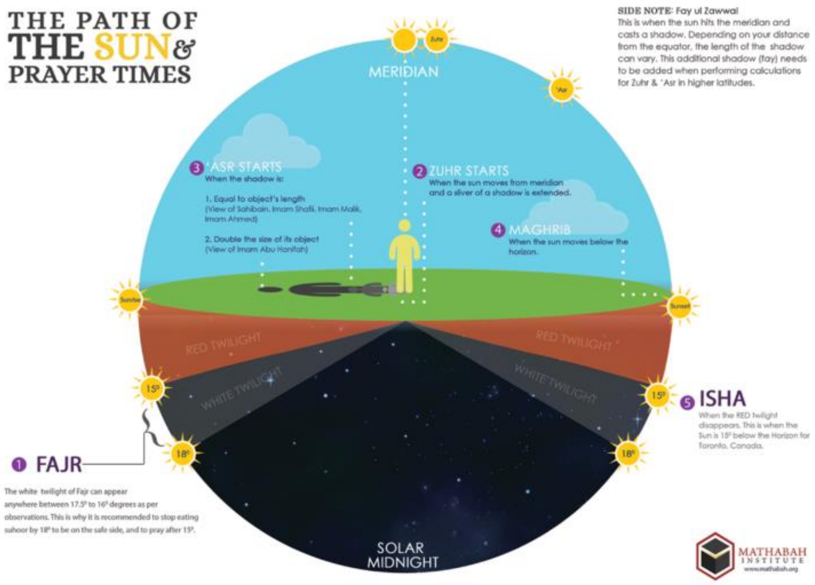

Figure 1. The Path of the Sun at Prayer Time

The Abd. Jalil Manaf Husaini was born in Penyasawan Air Tiris on July 7, 1913, he is a creator of prayer time schedules throughout Riau Province and is also one of the Imams of the Annur Grand Mosque of Riau . During Abd's life,[4] Jalil Manaf Husaini pursued Falakiyah knowledge by studying the journey or circulation of the moon, stars and sun. As one of the signs of his intelligence, the King of Johor or Raja Ja'far appoint Abd. Jalil Manaf Husaini taught astronomy to his children, and he was even adopted as the son of the King of Johor .

Among his works, Abd. Jalil Manaf Husaini will make a schedule for Imsyakiah Ramadan for Singapore and Johor and for prayer times for the province of Riau [5].The prayer time schedule prepared by Abd. Jalil Manaf Husaini is different from other prayer time schedules, such as the all-time prayer time schedule published by the Hisab Rukyat Agency of the Ministry of Religion, Riau Provincial Regional Office, which uses a modern hisab system. Where in determining the prayer time Abdul Jalil Manaf Husaini stipulates that the change time changes within five days, while the schedule made by the Hisab Rukyat Agency of the Ministry of Religion Riau Provincial Office in determining the beginning of the month of Kamariah is very important for Muslims because it is related to worship [6], which is implemented in the calculation of the month of Kamariah [7], such as fasting and

Hajj [8]. In this case, there are two systems held by hisab experts in determining the beginning of the month of Kamariah, namely:

1) The Ijtimak (conjunction) system, the group that adheres to this system stipulates that if ijtimak occurs before sunset, the beginning of the new moon has entered from sunset.
2) The hilal position system, the group that adheres to this system determines that if at sunset the position of the hilal is already above the horizon, then it is from sunset that the moon begins to be counted.

For adherents of the ijtimak system, it is further divided into several streams, namely:

a. ijtimak qabla al-ghurub ; this school associates the time of ijtimak with the time of sunset, with the criterion that if ijtimak occurs before sunset, then the night is considered a new moon (newmoon).
b. Ijtimak qabla al-fajr, this school relates the beginning of the month of Kamariah to be determined at the time of ijtimak and dawn, with the criterion that if ijtimak occurs before dawn, then since dawn it has entered a new moon, and if ijtimak occurs after dawn, then the day after dawn is still included in the last day of the ongoing month of Kamariah.
c. Ijtimak and midnight, with the criterion for the beginning of the month is that if ijti mak occurs before midnight, then from midnight it has entered the beginning of the month. However, if ijtimak occurs after midnight, the night is still an ongoing month, and the month's beginning is set from midnight to the next.

Then the group that adheres to the hilal position system is also divided into several streams:

a. The group that adheres to the true horizon, this group proposes that the beginning of the moon is determined by the height of the moon's center point measured from the true horizon (the horizon that is 90^{o} away from the zenith point or the apex point of the celestial sphere).
b. The group that adheres to the mar'i horizon (visible horizon), this group determines that the beginning of the month begins to be calculated if at sunset the position of the moon's disk is already farther east than the position of the sun's disk, which is a measure of the direction East, in this case, is the Mar'i Horizon. It means that if at sunset high you see that the upper disk of the hilal is already above the horizon of mar'i, then since then the new moon has begun to be counted.

Based on the calculation of these data, it can be known when ijtimak occurs, the height of the hilal, the length of the hilal above the ufuq, the magnitude of the hilal light, and the azimuth [9]. An example is the calculation of the beginning of the month of Shawwal 1433 H. The result of Ijtima occurs on Friday the 17th August 2012 with a height of the moon - 5 degrees 6 and at sunset at 17:38 with the distance between the moon and the sun is 4 degrees 6 south of the sun. Thus, the beginning of the month of Shawwal 1433 H. falls on Sunday, August 19, 2012. To calculate the data of the movement (harakah) [10] of the sun and moon referred to above, the method is as follows:

First, Taking the average solar and lunar motion data for the tax year (the complete year or the year concerned minus one), for example, 1430 Hijriyah, the tax year is 1429. Second, motion data for the month of tam (al-syahr al-tam), which was the previous month, was taken. For example, what Ramadan is looking for, then the third month is Sha'ban. Furthermore, the data in the month of Tam is included in the calculation (for 5 types of harakah). Third, Taking data on the movement of the hour and minute at sunset that day, using the watatiyah clock, which is the actual time that has been corrected with the data ta'dil al-zaman (equation of time), so that it becomes the local wasatiyah clock (local mean time) Fourth; After entering all the data (from the first to the third step), then it is summed according to the type for constellations a maximum of 12.

IV. Conclusion

After discussing the analysis of the determination of the prayer time schedule along with abd at length, Jalil manaf husaini perspective of modern astronomy. The legal basis for determining the time of prayer throughout the period according to Abd. Jalil Manaf Husaini refers to the Qur'an verse of Surah An-Nisa' at the end of verse 103. That is, prayer is an obligation determined by the time for the believer. The logical consequence of the verse is that prayer cannot be performed at any time but must follow Nash. The method used by Abd. Jalil Manaf Husaini in compiling the all-time prayer time schedule using the sun's shadow for the Zuhur prayer time and Asr, and for the time of prayer that is carried out at night, refer to the hadith of the Prophet PBUH and the number of fiqh scholars. The determination of the early afternoon time Abd. Jalil Manaf Husaini researched the sun using an istiwa' stick to take advantage of the sun's shadow. The Introduction of Modern Astronomy (contemporary hisab) is in the process of determining the schedule of prayer times throughout the time according to Abd. Jalil Manaf Husaini, there are differences and similarities, as well as advantages and disadvantages of the prayer time schedule compiled by Abd. Jalil Manaf.

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Hijri Calendar in Sharia Business Management

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ABSTRACT

The Hijri calendar is a time marker with essential implications in Sharia management and accounting. This article will discuss the role of the Hijri calendar in Sharia business management and how its application can influence business decisions and accounting practices according to Sharia principles. The main focus of the research is to examine some Hijri calendars designed by Jamal Eddine Abderrazik and the other versions. This research will analyze the accuracy of the method.

The Hijri calendar plays a central role in Sharia business management and accounting. This Calendar allows Islamic businesses to comply with Islamic law in every aspect of their operations, from the timing of Zakat to recording financial transactions. Integrating the Hijri calendar in Sharia management and accounting is about compliance with religious law and managing business ethically and sustainably following Islamic values.

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I. Introduction

As perfect beings, humans have advantages that allow them to manage their affairs well. An accurate and appropriate dating system is needed to support regularity in daily routines. There are several types of calendar systems, including the solar calendar system and the lunar calendar system [1]. The solar calendar system refers to one day as the period in which the Earth rotates once, while a year is when it takes to go around the sun once [2]. Humans currently use two calendar systems: the Christian Calendar, commonly used, and the Hijri calendar, which Muslims use.

The Christian Calendar is the most well-known and familiar one among humans, as it is widely used daily [3]. The Christian calendar, currently used in Indonesia, was adopted from the Roman Calendar. This Calendar has undergone several changes, including changes to the system, month name, number of days, and other aspects. The Christian Calendar follows the Lunisolar system, which refers to the circulation of the sun and moon. In the Roman Calendar, seven out of 12 months have 29 days, while the other four months have 31 days, and one month has 28 days to correspond to the sun's movement [4].

The Christian Calendar is an international system used as a standard for setting dates globally. This calendar system is based on the movement of the Earth's revolution around the sun, and one cycle begins at 00.00 (midnight). Sometimes referred to as the "Gregorian calendar," this Calendar is a correction of the previous Calendar, the Julian calendar. The correction was made to perfect the calculation of the period of the Earth's revolution around the sun. Previously, the Julian calendar had a year length of 365 days and 6 hours, which was later corrected to 365 days, 5 hours, 48 minutes, and 46 seconds in the Gregorian Calendar. However, in modern astronomical practice, we use the estimate that a year is 365.25 days, and every four years, there is a leap year. Therefore, it can be estimated that in 3000 years, there will be a reduction of about 5-8 days. The 12 months in the Christian Calendar are shown in Table 1.

Table 1. Gregorian Months

No	Name	Days
1	January	31
2	February	28/29
3	March	31
4	April	30
5	May	31
6	June	30
7	July	31
8	August	31
9	September	30
10	Oktober	31
11	November	30
12	December	31

The Hijri calendar is a system developed based on the circulation of the moon around the Earth. This Calendar was formed to guide Muslims uniformly [5]. In the Hijri Calendar, a day/date begins at sunset, unlike the Gregorian Calendar, which begins at sunrise. The Hijri calendar is made based on the cyclical cycle of the Qomariah calendar month. Using the lunar cycle, the number of days in a year is about 354,367 days, which explains why a Hijri calendar year is shorter by about 11 days than a calendar year [6]. Based on the synodic movement of the moon, the Hijri calendar is for 29.5309 days or 29 days 12 hours 44 minutes 2.8 seconds. Within 12 months, it will reach around 354,367 days or 354 days, 8 hours, 48 minutes, and 35 seconds [7]. The 12 months in the Hijri calendar are shown in Table 2.

Tabel 2. Hijri Months

No	Name	Days
1	Muharram	30
2	Safar	29
3	Rabiul Awal	30
4	Rabiul Akhir	29
5	Jumadil Awal	30
6	Jumadil Akhir	29
7	Rajab	30
8	Sya'ban	29
9	Ramadhan	30
10	Syawal	29
11	Zulqaidah	30
12	Zulhijjah	29

The names of the months in the Hijri calendar are not the result of the ijtihad of Umar bin Khattab or even the Prophet Muhammad (peace be upon him) but the legacy of the previous Arab civilization.

II. Method

This research is an in-depth literature research. The main focus of the research is to examine some Hijri calendars designed by Jamal Eddine Abderrazik and the other versions. This research will analyze the accuracy of the method. Research data was obtained from various books, reports of previous research results, and various other supporting literature. This study aims to evaluate the relevance and accuracy of the Calendar.

III. Results and Discussion

Hijri Calendar

Muslims use the Hijri calendar worldwide to determine the time of worship, celebrations, and religious obligations. In the context of Sharia business management, the Hijri calendar also has an important role. Many business decisions, such as the timing of zakat payments, the distribution of profits, and the execution of contracts, are based on specific dates in the Hijri calendar [8] A global calendar is used for a calendar that is evolving in today's world. There are many different types and criteria.

1. ISESCO Calendar (Islamic Educational Scientific and Cultural Organization)

It is a calendar designed by Jamal Eddine Abderrazik who accepted at the results of the Expert Meeting II in Morocco between the Association of Marocaine d'Astronomie (AMA) and the International Islamic Call Society (IICS). Next

2. Ummul Qura Calendar

This Calendar was adopted by the Saudi Arabian government and designed by the Astronomy and Geophysics Research Institute under King Abdul Aziz City for Science and Technology (KACST). The parameters in this Calendar are the same criteria as those of the Muhammadiyah, namely *wujudul hilal*. The principle of the Ummul Calendar The Qur'an is as follows: First, if the sun sets in Mecca after ijtimak, the moon has not yet set, then the next day is a new moon.

3. Single Calendar of Istanbul Verdicts

The Islamic Calendar, or Hijri calendar, plays a crucial role in the lives of Muslims, guiding religious observances and cultural practices. Various criteria are employed worldwide for the determination of the lunar months. Among these, the Turkish Criterion has gained prominence for its systematic approach to harmonizing religious and scientific methodologies. Calendar of the results of the 2016 International Congress in Turkey parameters in the creation of the Global Hijri calendar with the provisions as follows:

a. Calendar Zone

One day, one date around the world means that on the entire surface of the Earth, The whole world enters the beginning of the month on the day that same.

b. Calendar Rules

All hemispheres of the world start the new moon together the next day with the conditions If there has been imkan rukyat with the Criterion of 5.8 (height of the hilal 5 degrees and an elongation angle of 8 degrees throughout the world before 12:00 p.m. WU/GMT (00:00 p.m.). Moreover, there is an Exception, for if the imkan rukyat occurs after 12:00 GMT/ 07:00 WIB, it is declared as a new moon with the following conditions: First, meet the criteria for the height of the hilal above the horizon of 5 degrees and The elongation angle of 8 degrees has occurred ijtimak qabla dawn in New Zealand. Second, Imkan rukyat occurs on the mainland of the American continent, and if it occurs in the ocean, it is not considered.

The Role of the Hijri Calendar in Sharia Accounting:

The Hijri calendar affects transaction recording and financial reporting in Islamic business. For example, year-end adjustments to report Zakat or waqf must be made based on the Hijri year.

In general, a transaction can be interpreted as an economic/financial event that involves at least two parties (a person with a person or several other people) who exchange with each other, involve themselves in a business association, borrow and borrow based on mutual consent or based on an applicable legal or sharia provision.

Sharia accounting also considers essential events in the Hijri calendar, such as the month of Ramadan, where business activities may undergo significant changes, and this needs to be considered in financial planning. Some crucial aspects of Sharia accounting that are influenced by the Hijri calendar include:

1. Financial Reporting Period. In many companies that operate under Sharia principles, the accounting period often follows the Hijri year rather than the AD year. It occurred to ensure compliance with essential events in the Islamic Calendar, such as Ramadan, Eid al-Fitr, and Eid al-Adha. Using the Hijri year in the reporting period also affects how financial obligations, such as Zakat, are calculated, which depends on the Hijri annual cycle.

2. Zakat Calculation and Payment: Zakat is one of the pillars of Islam and has significant accounting implications. Companies and individuals operating following sharia must calculate and pay Zakat at a predetermined time based on the Hijri calendar. Zakat is calculated based on assets owned during one Hijri year (haul) and must be paid at the year's end [9]. Sharia accounting requires accurate recording to ensure that zakat obligations are fulfilled on time and that Sharia rules are followed. For example, if a company uses the AD calendar for financial statements, it is necessary to make adjustments to calculate Zakat based on the Hijri year.

3. Business Transactions and Timing: Many business transactions in the Sharia environment are aligned with specific dates in the Hijri calendar. For example, the implementation of contracts is often adjusted to essential dates in the Hijri calendar, such as the beginning of the month of Muharram or on the eve of the month of Ramadan. In addition, in Sharia accounting, the recognition of income or expenses may be adjusted to the Hijri calendar to reflect slower or faster business activity during certain months, such as Ramadan, where working hours may be reduced and business activities decrease.

4. Islamic Financial Statements: Financial statements in sharia accounting must reflect compliance with sharia principles, including the use of the Hijri calendar. Annual reports, income statements, and balance sheets in Islamic businesses may need to be prepared by considering the Hijri calendar to provide an accurate picture of financial performance per the Hijri year cycle. Using the Hijri calendar in reporting can also provide a more relevant context for Muslim stakeholders, who may better understand and appreciate financial information in Islamic time frames.

Implications of Using the Hijri Calendar in Sharia Accounting

Integrating the Hijri calendar in sharia accounting is not only a technical aspect but also reflects the company's commitment to comply with sharia principles in all operations. Using the Hijri calendar helps ensure that financial and business management decisions are made in a manner that aligns with Islamic values. It also gives the stakeholders confidence that the company operates for economic gain and to fulfil their religious and social responsibilities.

Thus, the Hijri calendar ensures that Sharia accounting practices comply with conventional accounting standards and integrate Islamic values into day-to-day business management. Currently, many Muslims are not aware that the absence of the Hijri Calendar not only affects the rituals of worship of Muslims, but the absence of a calendar has an extraordinary economic and Sharia impact. Furthermore, the form or types of transactions at Sharia financial institutions are related to the Hijri calendar and relative civil interests. Sharia financial institutions have the same basic principles, including Sharia Commercial Banks and Sharia Business Units.

Among others, the principle of custody or deposit, profit sharing or profit and sharing, sale and purchasing), lease (Operational Lease and Financial Lease), and Service (fee-based Service) [10]. Meanwhile, if we look at Sharia business activities, they can be classified into the following forms:

a. Fundraising: Current Account Deposits. A customer's deposit transaction also requires apparent certainty of the transaction, date, month, and year to organize life in the future. It could be the customer depositing the money within one year, which will be taken later to coincide with 9 Dzulhijah for the sake of sacrifice on the 10th of Dzulhijah. Deep LKS must have guidelines for the Qomariyah calendar that can guarantee transaction certainty.

b. Distribution of Funds: Principles of Buying and Selling: murabahah, salam and istisna'i. This type of effort does not cause much trouble because it is irrelevant to worship and civic interests. Furthermore, it contains the principle of profit sharing: Mudharabah, Musharakah. These two types of businesses require a Hijri calendar; for the mudharib if he is going to pay zakat mal, then use The Hijri calendar, not the Shamsiyah calendar. If the Syamsiah calendar is used, there will be a shortage of 11 days each year. This means that the impact of non-existence. This hijri Calendar makes mudharib lack the payment of Zakat if It has been up to one year (haul). If the mudharib pays his Zakat is 12,000,000 / year, then he lacks the payment of his Zakat in one year of 372,881.00. It is assumed that only one person, while the population of Indonesia is the majority of Muslims, how many muzaki are lacking in payment Zakat? This is the answer because no hijri calendar can be used as guidelines or footholds. Thus, the absence of the hijri calendar results in a shortage of zakat payments, which have an impact on the economy and the social welfare of the Muslim community, especially in Indonesia. Following Tono Saksono's term, lacking zakat payment, has become a debt civilization because only a handful of Islamic organizations and banking, DPS understand the Hijri calendar that can be implemented according to Shari'ah [11].

c. Services which include wakalah, hawalah, kafalah and Rahn. In this case, the bank is the customer's representative as a proxy (muwakil) to do something (taukil). So, in this case, the bank will get a wage or administrative fee because of services earlier. Booking or purchasing tickets greatly impacts holidays ahead of 1 Shawwal (Eid al-Fitr) and 10 Dzulhijah (Eid al-Adha). There is no standard calendar, so the customer is experiencing chaos in arranging his activities. For those who work, he must arrange how many days they must take leave. If the Eid al-Fitr and Eid al-Adha holidays are known, we can manage the time in the future.

IV. Conclusion

The use of the Hijri calendar is the main topic taught in the Astronomy curriculum in the Shari'ah department. The Hijri calendar plays a central role in Sharia business management and accounting. This Calendar allows Islamic businesses to comply with Islamic law in every aspect of their operations, from the timing of Zakat to the recording of financial transactions. Integrating the Hijri calendar in Sharia management and accounting is about compliance with religious law and managing the business ethically and sustainably following Islamic values.

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The Role of Observatory in Observing and Teaching Astronomy to Students

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ABSTRACT

The Sultan Zainal Abidin University Observatory (UniSZA) plays an important role in teaching students astronomy and celestial body observation. This observatory seeks to increase students' interest and understanding of astronomy through various interactive programs and activities. Modern facilities such as state-of-the-art telescopes and miniature planetariums allow students to observe celestial bodies in detail and take part in simulations of various astronomical phenomena. This study uses observation and interview methods to collect data from activities organized by the observatory and interviews with students, teachers, and teaching staff at UniSZA. The educational programs offered, including educational visits, astronomy workshops, and astronomy classes, are designed to introduce the basic concepts of astronomy in an engaging and fun way. This article examines the contribution of UniSZA observatories in educating children about astronomy, the methods used to teach astronomy, and the impact of these programs on students' interests and understanding. Thus, this observatory is a centre for observing celestial bodies and an effective educational means for school children. This research also identifies the challenges faced and solutions that can be implemented to improve the effectiveness of existing programs. The UniSZA Observatory is expected to continue to create a younger generation interested in and understanding astronomy and encourage the development of science in Malaysia.

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I. Introduction

Astronomy is a science that studies celestial bodies and the phenomena of the universe. Education about astronomy in school children is often challenging because of its abstract nature and is difficult to understand without visual aids and direct experience. The UniSZA Observatory is here as a solution to introduce and teach astronomy [1] to school children interactively and interestingly.

Astronomy is unique as a science that can inspire a sense of wonder and natural curiosity in humans. Since ancient times, humans have been interested in the night sky and the phenomena they observe. According to [2] astronomy teaches students to think critically and analytically and encourages them to ask questions about their place in the universe. Thus, astronomy is important from a scientific point of view and an educational and cultural perspective.

However, astronomy is often a very small part of many school curricula. As [3], teaching astronomy can improve students’ understanding of scientific concepts. Astronomy education can develop critical thinking and problem-solving skills, crucial in STEM (Science, Technology, Engineering, and Mathematics) education.

Although important, the teaching of astronomy faces various challenges. First, many concepts in astronomy are abstract and cannot be directly observed without the help of special tools. For example, phenomena such as star formation, galactic structure, and the universe’s expansion require a deep understanding of physics and mathematics. According to [4], students often feel intimidated by this complexity. They may lose interest if the material is not delivered in an engaging and easy-to-understand manner.

In addition, the limited facilities in schools are also an obstacle. Not all schools have telescopes or access to planetariums, which can help students see celestial bodies firsthand. As stated by [5], visualization is essential in teaching complex scientific concepts, and a lack of access to these tools can hinder students’ comprehension.

Observatory, with its state-of-the-art facilities and structured educational programs [6], can be a solution to address these challenges. The observatory allows students to observe celestial bodies firsthand and learn through practical experience. According to a report from [7] this hands-on experience can increase students’ interest in science and deepen their understanding of scientific concepts.

The Observatory of Universiti Sultan Zainal Abidin (UniSZA) in Malaysia has become one of the main centres for teaching and observing astronomy. With various modern facilities, such as state-of-the-art telescopes and a mini planetarium, the observatory provides a means for students to observe celestial bodies and understand the basic concepts of astronomy. UniSZA utilizes this observatory as an educational institution to offer an interactive and immersive learning experience, which aims to increase students' interest in astronomy and deepen their understanding of the universe [8].

One of the flagship programs at the UniSZA Observatory is educational visits. The program is designed to provide students hands-on experience observing celestial bodies through telescopes. In each visit, students are invited to observe planets, stars, and other celestial objects while getting explanations from the teaching staff regarding the characteristics and phenomena observed. These educational visits improve students' understanding of astronomy and arouse their sense of amazement and curiosity towards science [3].

In addition to educational visits, the UniSZA Observatory also organizes astronomy workshops that involve students in practical activities. The workshop includes various activities, such as modelling the solar system, understanding the moon's phases, and learning the basic principles of operating telescopes. These practical activities are designed to help students understand scientific concepts through hands-on experience, which has proven effective in improving their understanding of astronomy [9]. The workshop also encourages active student engagement so they can learn in a more fun and immersive way.

Astronomy classes are another program offered by the UniSZA Observatory. This class explains astronomical phenomena in-depth, including planetary movements, star structures, and other celestial phenomena. Using an interactive and visual approach, astronomy classes help students understand complex concepts in a way that is easier to follow. According to [10], using visual methods in teaching astronomy is very effective in increasing students' understanding and interest in the topics being taught.

These programs' influence significantly increases students' interest and understanding of astronomy. The study results showed that students participating in these observatory programs increased their interest and knowledge of astronomy. The support of modern facilities and the interactive approach applied by the UniSZA Observatory have succeeded in creating an inspiring learning environment and supporting effective learning. By continuing to innovate and develop existing programs, the UniSZA Observatory is expected to continue to contribute significantly to astronomy education in Malaysia [4].

II. Method

This study uses a qualitative approach with observation and interview methods. Data were collected through direct observation of activities organized by the observatory and interviews with students, teachers, and teaching staff at UniSZA. Analyzing the programs used to help students understand astronomy. The results would be categorized into programs requiring student participation in these observatory programs.

III. Results and Discussion

The UniSZA observatory is a good example of an institution using its facilities to support astronomy education. With state-of-the-art telescopes, a mini planetarium, and an educational room equipped with teaching aids, this observatory can provide a comprehensive learning experience for students. The programs organized by the observatory, such as educational visits, astronomy workshops, and astronomy classes, are designed to make astronomy interesting and easy to understand. The UniSZA Observatory organizes a variety of educational programs designed specifically for school children, including:

Educational Visits

The educational visit program at the UniSZA Observatory is designed to provide students with hands-on experience in observing celestial bodies. According to [3], this hands-on experience is crucial in science learning because it helps students relate theories to real observations. During this visit, students were invited to observe celestial bodies through telescopes and listen to explanations from teaching staff about the objects observed. This program improves students' understanding of celestial bodies and fosters their sense of wonder and curiosity. The program also helps children develop critical and analytical thinking skills. Through direct observation and practical activities, children learn to observe, analyze, and draw conclusions based on the collected data. This ability is very important in science education and can be applied in various areas of life [11].

Astronomy Workshop

The astronomy workshop at the UniSZA Observatory engages students in practical activities that help them understand the basic concepts of astronomy. For example, students can model the solar system, study the moon's phases, and understand the basic principles of operating telescopes. According to a study by [9], practical activities can improve students' understanding of scientific concepts because they can see firsthand how theory is applied in practice.

The workshop involved practical activities such as modeling the solar system, direct observation through a telescope, and simple experiments explaining astronomical phenomena. According to a study by [10], practical activities like this can increase students' understanding and interest in science because they can see firsthand how theory is applied in practice. The workshop is also designed to encourage active participation from children so that they can learn while playing and experiment.

Astronomy Classes

Astronomy classes organized by the UniSZA Observatory provide an in-depth explanation of various astronomical phenomena. This class covers the movement of planets, stars, and other celestial phenomena. These classes use an interactive and visual approach to help students understand complex concepts more easily and engagingly. According to a study by [10], using visual methods in astronomy teaching can increase students' understanding and interest.

The regular Children's Astronomy class covers basic topics such as the solar system, moon phases, stars, and planets, presented in an engaging and easy-to-understand way for children. Interactive teaching methods, such as solar system models, pictures, and videos, help children understand concepts that may be difficult to understand through text alone [9].

In addition, the observatory also provides training for science teachers to improve their understanding of astronomy and how to teach it. By providing adequate training, teachers can feel more confident and ready to teach astronomy, improving the quality of astronomy education in schools.

Impact of UniSZA Observatory Educational Program

The educational programs at the UniSZA Observatory have positively impacted students' interest in and understanding of astronomy. Observational studies and interviews with students and teachers show that students who participate in these programs increase their interest and understanding of astronomy. According to the results of research conducted by the observatory, many students who were previously not interested in science become more enthusiastic after participating in these programs. The findings of [2] state that direct experience in astronomical observations can foster long-term interest in science.

The astronomy learning program conducted by the UniSZA Observatory has shown a significant positive impact on children's interest and understanding of astronomy. Based on the results of research conducted by the observatory, students who participated in these programs showed an increase in their interest and knowledge of astronomy. Children become more enthusiastic about science and more interested in learning more about astronomy.

Challenges and Solutions

Although the programs at the UniSZA Observatory have succeeded in increasing students' interest and understanding, several challenges need to be addressed. One is the limited time and number of participants in each visit session. To address these challenges, the observatory can expand the visit schedule and increase the number of telescopes available. In addition, developing digital learning materials can be a solution to reach more students more flexibly. According to [11], using digital technology in science education can expand students' access to learning resources and increase their engagement.

By continuing to innovate and develop existing facilities and programs, the UniSZA Observatory is expected to contribute significantly to astronomy education in Malaysia. This observatory functions as a centre for observing celestial bodies and is an effective educational means for schoolchildren. With the support of the government and the community, the observatory can play a key role in creating a younger generation interested in and understanding astronomy and encouraging the development of science in Malaysia.

IV. Conclusion

The Observatory of Universiti Sultan Zainal Abidin (UniSZA) is essential in teaching astronomy and celestial body observation to school children. This observatory has increased students' interest and understanding of astronomy through various interactive educational programs. By continuing to innovate and develop existing facilities and programs, the UniSZA observatory is expected to contribute significantly to astronomy education in Malaysia.

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