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# Why was Islam Revealed in the Arabian Peninsula?: Significances of Arabia in the Formulation of Prayer Times

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***ABSTRACT***

This research sets out from two main problems. First, the climate uniqueness of the Arabian Peninsula as the place where Islam emerged. Second, the various views of western figures such as Ernest Renan and H.A.R. Gibb who seeks to reveal the existence of a link between Islam and Arab. This research aims to reveal the significances of the Arabian Peninsula's latitude in prayer times formulation and to discuss the link between Islam and Arab. The data are obtained from simulation of the Sun and twilight appearance in Prophet Muhammad time. Simulation using Stellarium software. The time setting for simulation are June 19 and December 19 in 622. The locations examined are Al Bahiyah, Mecca, Turaif, Istanbul, and Gukovo. The simulation results are then compiled into a table to present the beginning of prayer times in each city. This research shows that the significances of the Arabian Peninsula'latitude in prayer times formulation consist of two factors: 1) the ease of observing the sun and dawn; 2) a minimum of cloud and rain phenomena. Based on the analysis of the five cities's latitude, Mecca is considered as the most ideal location in prayer times formulation among the cities. This research provides another perspective in revealing the link between Islam and Arab.

***Keywords*** : Arabian Peninsula, Mecca, Latitude, Prayer Times

**ABSTRAK**

Penelitian ini berangkat dari dua persoalan utama. Pertama, keunikan iklim Jazirah Arab sebagai tempat turunnya Islam. Kedua, berbagai pandangan tokoh-tokoh barat seperti Ernest Renan dan H.A.R. Gibb yang berupaya mengungkap adanya link antara Islam dan Arab. Penelitian ini bertujuan untuk menunjukkan signifikansi posisi lintang Jazirah Arab dalam formulasi waktu-waktu salat dan untuk mendiskusikan link antara Islam dan Arab. Sumber datanya berupa simulasi ketampakan Matahari dan fajar pada masa awal diturunkannya perintah salat. Simulasi menggunakan software Stellarium. Waktu simulasi diatur pada tanggal 19 Juni dan 19 Desember tahun 622. Lokasi yang diuji adalah Al Bahiyah, Mekah, Turaif, Istanbul, dan Gukova. Data simulasi selanjutnya dihimpun ke dalam tabel sehingga menghasilkan awal waktu salat di masing-masing kota. Hasil penelitian ini menunjukkan bahwa signifikansi posisi lintang Jazirah Arab dalam formulasi waktu salat ditunjukkan oleh kemudahan dalam mengamati Matahari dan fajar. Selain itu, posisi lintang Jazirah Arab yang tidak terlalu dekat dengan ekuator menyebabkan minimnya fenomena awan dan hujan. Berdasarkan analisis posisi lintang dari 5 kota, Mekah dipandang sebagai lokasi yang paling ideal dalam formulasi waktu-waktu salat dibandingkan dengan kota lainnya. Penelitian ini memberikan perspektif lain dalam mengungkap link antara Islam dan Arab.

***Kata Kunci*** : Jazirah Arab, Mekah, Lintang, Formulasi, Waktu Salat

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## INTRODUCTION

The Arabian Peninsula is characterized by its hot and arid environmental conditions, distinguishing it from most other regions of the world. According to the Köppen climate classification map, the Arabian Peninsula is predominantly depicted in red, indicating an arid desert climate (Beck et al., 2018). The Arabian Peninsula experiences a predominantly hot climate, with temperatures in certain regions reaching up to 51°C (Patlakas et al., 2021). In the Arabian Peninsula, the dry season generally extends from June to August, primarily due to the apparent annual motion of the Sun (BMKG, 2019). The apparent annual motion of the Sun is intrinsically linked to a location's latitude, which plays a significant role in shaping its climatic characteristics (Rodrigues et al., 2016; Tjasyono, 2009). Accordingly, the unique climatic characteristics of the Arabian Peninsula are also shaped by its latitudinal position.

A region's latitude significantly influences the normality of Islamic prayer times. Consequently, it is difficult to envision how prayer time formulations would have developed had Islam emerged in a high-latitude region. For instance, in Brussels, Belgium (50° 51′ 1.223″ N, 4° 21′ 6.157″ E), the phenomenon of nighttime does not occur on 21 June (Thorsen et.al., 2023). As a result, the astronomical indicators marking the beginning of the ʿIshāʾ and Fajr prayer times disappear. At even higher latitudes, such as Aykhal, Russia (66° 36′ 36.61″ N, 107° 47′ 47.79″ E), the Sun neither rises nor sets on the same date, resulting in the absence of the astronomical indicators for the Maghrib, ʿIshāʾ, and Fajr prayer times (M. Odeh, 2022). This demonstrates that the conventional Sharīʿah-based criteria for determining the commencement of prayer times cannot be universally applied across all locations on the Earth's surface.

Various speculative perspectives have emerged in an effort to uncover the relationship between Islam and the Arabian Peninsula. These studies seek to trace the characteristics of Islamic teachings in relation to the socio-geographical conditions prevailing at the time of their emergence. Ernest Renan (1860), for instance, argued that monotheistic religions such as Islam originated among societies whose geographical environment was characterized by desert landscapes (Gibb, 1948; Iskandar, 2023). By contrast, Gibb (1949) challenged Renan's thesis by proposing that Islam emerged in Arabia and spread rapidly across the world because it was propagated by a society whose way of life was centered on trade (Gibb, 1948). Hienz (2008) maintained that the Islamic practice of the five daily prayers constitutes a syncretic tradition influenced by Zoroastrianism, Judaism, and the indigenous religious beliefs of the Arabian people (Hienz, 2008). Fundamentally, these arguments attempt to establish a relationship between Islam and the Arabian Peninsula. However, they fail to address one of the central rituals of Islam, namely the determination of prayer times, which is intrinsically associated with a location's latitude.

The issue of prayer times in relation to latitude across different regions of the world has also received considerable scholarly attention. This topic is of particular interest because the determination of prayer times at certain latitudes cannot always be resolved solely through astronomical calculations. Sa'adoeddin Djambek, for example, examined the determination of prayer times in high-latitude regions by integrating the principles of Islamic jurisprudence and astronomy (Djambek, 1974). According to Ismail’s studies, the altitude significantly influences the calculation of Maghrib, Isya, and Subuh prayer times, while sky brightness primarily affects the determination of Isya and Subuh prayer times (Ismail, 2015). The International Astronomical Center (IAC), an international Islamic astronomical organization chaired by Odeh, maintains that prayer times in high-latitude regions should follow those observed in the nearest region with normal astronomical conditions (M. S. Odeh, 2019). An international conference held in Gothenburg, Sweden, also sought to establish standardized solar altitude criteria for the ʿIshāʾ and Fajr prayer times, while proposing solutions for situations in which the astronomical indicators of prayer times disappear (Islamiska Sunni Centred, 2019). Previous studies have


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resolved the issue of determining prayer times across various latitudes worldwide. However, they have yet to address the significance of the Arabian Peninsula's latitude in shaping the formulation of Islamic prayer times.

This study seeks to address the gap in the existing literature by approaching the issue from the perspective of Islamic astronomy (ʿilm al-falak), a field that has not yet comprehensively examined the significance of the Arabian Peninsula as the birthplace of Islam. Existing studies have primarily focused on the geographical characteristics of the Arabian desert or on the socio-cultural characteristics of Arab society. Accordingly, this article addresses two principal questions: (1) What is the significance of the Arabian Peninsula's latitudinal position in the formulation of Islamic prayer times? and (2) What relationship can be established between Islam and the Arabian Peninsula through the formulation of prayer times? Answering these questions provides a theological basis for understanding why the Arabian Peninsula constitutes the most appropriate geographical setting for the emergence of Islam. Furthermore, the findings offer a scholarly justification for the centrality of the Arabian Peninsula as the spiritual orientation of the Muslim world.

## METHODS

This study adopted a qualitative research paradigm employing a library research design. The data consisted of simulated observations of the Sun and astronomical dawn, which were compiled into tables to determine prayer times in the Arabian Peninsula, as well as in middle- and high-latitude regions. The selected sample locations comprised the southernmost city of the Arabian Peninsula (Al Bahiyah, Yemen), a city located in the central Arabian Peninsula (Mecca, Saudi Arabia), the northernmost city of the Arabian Peninsula (Turaif, Saudi Arabia), a representative middle-latitude city (Istanbul, Türkiye), and a representative high-latitude city (Gukovo, Russia). Simulations of the Sun and astronomical dawn for these locations required latitude data, which were obtained from Google Earth. The simulations were conducted for the year 622 CE, corresponding to the early period in which the obligation of the five daily prayers was established. This historical setting was chosen to provide a more accurate representation of prayer times during the Prophet Muhammad's era. In addition, the simulations examined two astronomical conditions: when the Sun reached its northernmost declination (19 June 622) and when it reached its southernmost declination (19 December 622).

The solar altitude under these conditions was visualized using the Stellarium software. The resulting data were subsequently analyzed using descriptive and comparative approaches. The descriptive analysis involved a detailed interpretation of the simulation outputs generated by Stellarium, particularly with respect to the commencement of the prescribed prayer times. In addition, a simple calculation of the shadow length at the beginning of the ʿAṣr prayer was performed to complement the prayer time tables. The comparative analysis was conducted by comparing the prayer times of the selected cities in the Arabian Peninsula with those of the representative cities located in the middle- and high-latitude regions. Furthermore, the comparative analysis sought to identify the location within the Arabian Peninsula that provides the most suitable setting for the formulation of Islamic prayer times through the application of climate theory. The final stage of the study involved drawing the research conclusions.

## RESULTS AND DISCUSSION

### A. Prayer Times Formulation in Islam

The Qur'anic basis for the obligation of the Fajr prayer is found in Sūrat al-Rūm (30:17). According to Ibn Kathīr's exegesis, this verse indicates the command to perform the Fajr prayer as an act of glorifying Allah at the approach of daytime (Katsir, 1999). With regard to its prescribed time, a ḥadīth narrated by ʿAbd Allāh ibn ʿUmar states that the time for the Fajr prayer begins with


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the appearance of dawn and continues until just before sunrise (Jabbaar, 2014). In some countries, the beginning of the Fajr prayer is defined by the Sun reaching an altitude of 20° below the horizon (Djambek, 1974). Other countries, however, define the beginning of the Fajr prayer when the Sun is between 17° and 18° below the horizon (Azhari, 2017).

The Qur'anic basis for the commencement of the Ẓuhr prayer is found in Sūrat al-Isrāʾ (17:78). According to al-Ṭabarī's exegesis, the term al-dulūk in this verse is synonymous with al-mayl, meaning "inclination" or "decline" (Thabari, n.d.). This is because the commencement of the Ẓuhr prayer is marked by the Sun's apparent decline toward the west after crossing the local meridian. In prayer time calculations, most scholars of Islamic astronomy, including Saadoeddin Djambek, maintain that the Sun requires approximately two minutes after zawāl (its westward departure from the meridian) before the time of Ẓuhr begins (Jayusman, 2012). However, a ḥadīth narrated by Jābir ibn ʿAbd Allāh indicates that the Prophet performed the Ẓuhr prayer within two temporal limits: from the moment the Sun had passed the meridian (zawāl) until an object's shadow became equal to its own length (An-Nasa'iy, 2001). This is entirely consistent from an astronomical perspective. During the winter season in Mecca, the Sun is positioned south of the celestial equator, resulting in a lower solar altitude at local noon. Consequently, an object's shadow at solar transit is longer than when the Sun is positioned farther north (Azhari, 2018).

The Qur'an does not explicitly specify the commencement of the ʿAṣr prayer time. However, a ḥadīth narrated by Jābir ibn ʿAbd Allāh describes the beginning of the ʿAṣr prayer. According to this narration, the Angel Jibrīl instructed the Prophet regarding the prescribed prayer times. As with the Ẓuhr prayer, the Prophet performed the ʿAṣr prayer within two temporal limits: first, when an object's shadow became equal to its own length, and second, when its shadow reached twice the object's length (An-Nasa'iy, 2001). This difference is entirely consistent from an astronomical perspective. As discussed earlier, an object's shadow is longer during the winter season in Mecca than during the summer because the Sun is located south of the celestial equator, resulting in a lower solar altitude at local noon (Azhari, 2018).

One of the Sharīʿah evidences for the commencement of the Maghrib prayer is a ḥadīth narrated by Jābir ibn ʿAbd Allāh. This ḥadīth states that the time for the Maghrib prayer begins at sunset and continues until the commencement of the ʿIshāʾ prayer (An-Nasa'iy, 2001). Sunset refers to the moment when the Sun's upper limb, as observed from the Earth's surface, comes into contact with the horizon. Consequently, determining the Sun's altitude at the beginning of the Maghrib prayer requires several astronomical corrections, including the Sun's semidiameter, atmospheric refraction, and horizon depression (Depag RI, 1994). The Sun's altitude at the beginning of the Maghrib prayer is approximately 1° below the horizon (Djambek, 1974).

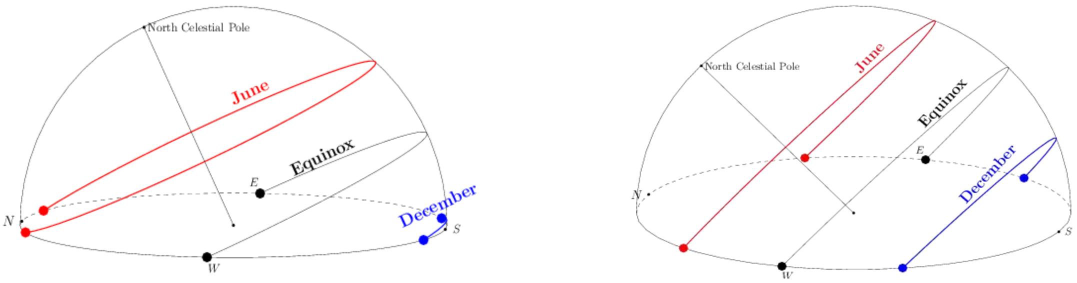
The time for the ʿIshāʾ prayer begins when the twilight (shafaq) has disappeared. This ruling is based on a ḥadīth narrated by Jābir ibn ʿAbd Allāh (An-Nasa'iy, 2001). However, the twilight (shafaq) visible on the western horizon after sunset consists of two types: red twilight (*shafaq al-aḥmar*) and white twilight (*al-shafaq al-abyaḍ*). According to the Shāfiʿī school and the majority of Muslim jurists (*jumhūr al-ʿulamāʾ*), the commencement of the ʿIshāʾ prayer is marked by the disappearance of the red twilight (*al-shafaq al-aḥmar*) (Al-Khin et al., 1992). In contrast to the Shāfiʿī school, the Ḥanafī school maintains that the time for the ʿIshāʾ prayer begins only after the disappearance of the white twilight (*al-shafaq al-abyaḍ*) (Hindi, 2004). Accordingly, according to the Ḥanafī school, the commencement of the ʿIshāʾ prayer occurs later than in the Shāfiʿī school. Based on the astronomical criteria adopted by the Shāfiʿī school, the time for the ʿIshāʾ prayer begins when the Sun reaches an altitude of 18° below the horizon (Djambek, 1974).

During the Prophet's lifetime, the most readily observable temporal indicators were those based on the Sun. This suggests that the determination of prayer times during that period relied entirely on the ability of the Prophet and his Companions to identify the prescribed times through direct observation of the Sun and other visible celestial phenomena. The commencement of the Ẓuhr and ʿAṣr prayers requires the visibility of the Sun's disk, whereas the commencement of the Maghrib, ʿIshāʾ, and Fajr prayers is respectively marked by sunset, the disappearance of twilight (shafaq), and the appearance of dawn (fajr). The foregoing discussion demonstrates that the formulation of Islamic prayer times is fundamentally based on the observable phenomena of the Sun and dawn.

## B. Effect of Latitude on the Sun Appearance

The Earth is divided into several latitudinal zones based on geographic latitude. This classification is useful for characterizing regions according to the annual distribution of solar radiation, which is closely associated with climatic zones. The tropical climate zone extends from 23.5° N to 23.5° S. Regions within this zone experience two overhead Sun events each year, during which the Sun is directly above the observer at local noon. The subtropical climate zone lies between 23.5° N and 35° N, and between 23.5° S and 35° S. These regions are characterized by four distinct seasons and are more frequently affected by natural phenomena such as storms, snowfall, and tornadoes. The temperate climate zone extends from 35° N to 66.5° N and from 35° S to 66.5° S. In this zone, the Sun generally remains at a relatively low altitude throughout the year, and the climate is characterized by more extreme weather conditions, including severe storms. Finally, the polar climate zone extends from 66.5° N to 90° N and from 66.5° S to 90° S. These regions experience prolonged winters during which the Sun remains at a very low altitude above the horizon (Winarno et al., 2019). Dari penjelasan ini, jelas bahwa posisi lintang suatu wilayah sangat memengaruhi ketampakan Matahari yang juga membawa pengaruh pada keadaan iklim.

The following illustration presents the differences in the apparent appearance of the Sun at two locations with different latitudes.




(a) Viewed from Iceland (b) Viewed from Rome

Figure 1. The Sun's path during sunrise and sunset at the June solstice (red), equinox (black), and December solstice (blue) (Bjarnadóttir, n.d.).

Figures 1a and 1b above show the Sun's path during the solstices and equinoxes as observed from Iceland, which is located at 64°57′46.984″ N latitude and 19°1′15.006″ W longitude (https://www.gps-latitude-longitude.com/, 2023a) and Rome, located at 41°54′10.022″ N latitude and 12°29′46.918″ E longitude (https://www.gps-latitude-longitude.com/, 2023b). The NWSE horizontal circle represents the horizon. The farther north the observer is located, the greater the inclination of the Sun's path relative to the horizon. As shown in Figure 1a, during the June solstice, the Sun's path begins and ends farther toward the north. Therefore, the Sun's path appears longer than that observed from Rome on the same date. Conversely, the apparent solar path during the December solstice is shorter when viewed from Iceland than when viewed from Rome.

As previously explained, latitude also influences climate (Tjasyono, 2009). This is due to the varying intensity of solar radiation received at different latitudes (Ribeiro et al., 2018).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The highest intensity of solar radiation occurs in the tropical zone. However, the peak of solar radiation does not occur at the equator but rather around 20° latitude in both the Northern and Southern Hemispheres. This phenomenon is a consequence of the abundance of water vapor, clouds, and overcast conditions in the equatorial zone. This is why high rainfall occurs near the equator. Precipitation decreases as latitude increases (Rodrigues et al., 2016). Thus, the latitude of a region influences its climate, as demonstrated by natural phenomena such as cloud cover and rainfall intensity, temperature, and solar radiation.

## C. Effect of Latitude on the Dawn Appearance

Dawn is the sunlight in the eastern sky that first appears before sunrise (Azhari, 2018). This type of dawn is also known as fajr ṣādiq or the true dawn (astronomical twilight). Astronomical twilight is the darkest of the three twilight phases. The first dawn, or astronomical twilight, can already be observed on the eastern horizon when the Sun's altitude is approximately 20° below the horizon (Djamaluddin, 2018). Some sources also state that this dawn can only be observed when the Sun's altitude is between 12° and 18° below the horizon (Flanders, 2007).

The appearance of dawn varies from one region to another. This is similar to the differences in the apparent appearance of the Sun at different latitudes. The following section presents Tony Flanders' observations of dawn appearances at several latitudinal locations on the Earth's surface, as illustrated in the following figures.

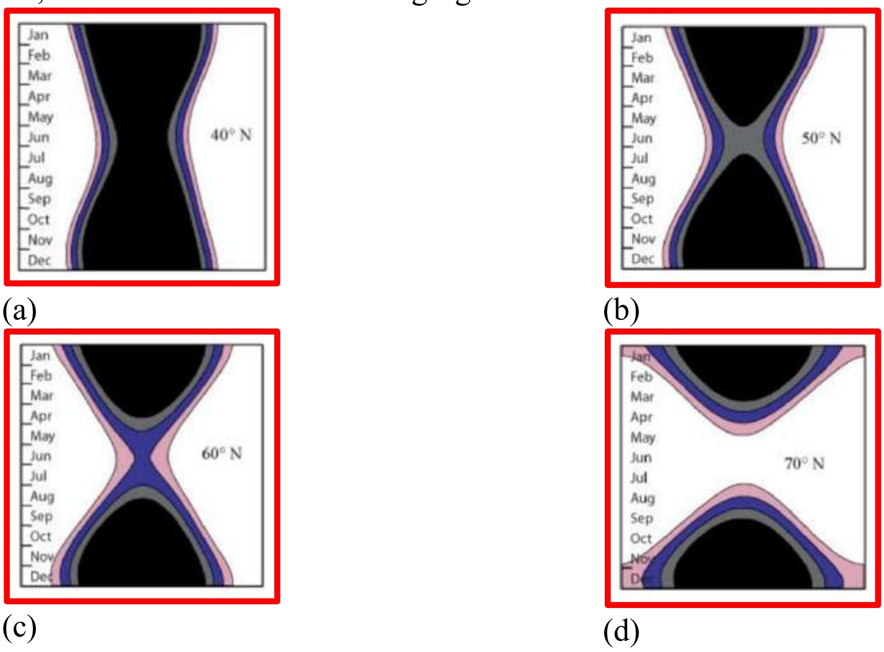


Figure 2. The appearance of twilight at various latitudes throughout the year (Flanders, 2007).

One of the characteristics of dawn (twilight) is that it is observed for a shorter duration at the equator and lasts longer as one moves toward the poles. This is also illustrated in Figure 2 above, where the differences can be compared among Figures 2a, 2b, 2c, and 2d. Figure 2a shows the visibility of the three types of twilight—astronomical twilight (gray), nautical twilight (dark blue), and civil twilight (pink)—at 40° N latitude. The horizontal axis represents a full 24-hour period. The unshaded areas indicate daytime. The far left and far right sides represent 12:00 noon local time, while the center represents midnight (00:00). Figure 2a illustrates that daytime lasts longer than nighttime at 40° N latitude around June. At this latitude, twilight occurs normally throughout the year.

Meanwhile, Figure 2b shows that at 50° latitude, nighttime does not occur for several days in June. During this period, only twilight and daytime are observed. At higher latitudes, as shown


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in Figure 2c, only nautical twilight occurs for several days in June. This indicates that the sky remains increasingly brighter. An even more extreme condition occurs at 70° latitude. For several months, only daytime occurs, meaning that the Sun remains above the horizon for a considerably long period.

Based on the illustrations and explanations above, it can be understood that the closer a region is to the poles, the more irregular the appearance of dawn becomes. This is similar to the irregularity in the apparent motion of the Sun. Such irregularities are characterized by the occurrence of continuous daytime or nighttime lasting for several days or even months. Furthermore, these irregularities are also indicated by prolonged twilight phenomena without the occurrence of night or day during certain months. The difference in the duration of daytime and nighttime also becomes increasingly significant in regions farther from the equator. This condition inevitably affects human life. Regarding the appearance of dawn, one of its implications concerns religious practices, particularly the determination of prayer times and the observance of fasting.

## D. Arabian Peninsula

The Arab Center Washington DC classifies the Arabian Peninsula as comprising nine countries: Saudi Arabia, Qatar, Bahrain, Kuwait, Oman, the United Arab Emirates, Iraq, Iran, and Yemen (arabcenterdc, 2023). However, many sources state that the Arabian Peninsula consists of only seven main countries: Saudi Arabia, Qatar, Bahrain, Kuwait, Oman, the United Arab Emirates, and Yemen (Dastrup, 2019; Nijim et al., 2023). The two countries that share borders with the Arabian Peninsula are Jordan and Iraq, although only small parts of their territories are included within the peninsula (Bender, 1975; Irvine et al., 2023). Therefore, to avoid ambiguity regarding the boundaries of the Arabian Peninsula, geographically, the Arabian Peninsula refers only to the seven main countries mentioned above.

The Arabian Peninsula is the largest peninsula in the world (Dodge, 2003). It covers an area of approximately 3,237,500 km². The peninsula is surrounded by three bodies of water: the Red Sea to the west, the Arabian Sea to the south, and the Persian Gulf to the east. The northernmost city of the Arabian Peninsula is Turaif, Saudi Arabia, while the southernmost city is Al Bahiyah, Yemen. The following is a map of the Arabian Peninsula.


Figure 3. Map of the Arabian Peninsula (Google Maps, 2015).

In general, the Arabian Peninsula is a dry region. Approximately 99% of its climate is classified as hyper-arid (HA) and arid (Almazroui et al., 2012; Kotwicki & Al Sulaimani, 2009). Its rainfall is among the lowest in the world. Saudi Arabia, for example, receives only about 4 inches of rainfall annually (Dastrup, 2019). The southern part of the Arabian Peninsula is located


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closer to the equator, making it part of the tropical zone and resulting in a warmer climate. In contrast, the northern part belongs to the subtropical zone. The northern and central regions of the Arabian Peninsula are extremely arid. This is because the northernmost part of the peninsula is not crossed by the Sun during its annual apparent motion and is therefore not affected by monsoon rainfall. This region is drier compared to the southern part. The southern and eastern regions, however, are influenced by monsoon rainfall. This is why the earliest civilizations of the Arabian Peninsula developed in these areas (Hoyland, 2001). Yemen, Mecca, and Medina are included within this zone.

## E. The Beginning of Prayer Times in the Arabian Peninsula and Higher Latitudes

The following section presents the beginning times of prayer during the Prophet's era in the Arabian Peninsula and beyond. The simulated and calculated prayer times are based on two conditions: (1) when the Sun was located at its northernmost position on 19 June 622, and (2) when the Sun was located at its southernmost position on 19 December 622. The criteria used are as follows: Fajr begins when the Sun's altitude is −18°, Dhuhr occurs at solar transit (without considering ihtiyāt or precautionary time), Asr begins when the length of an object's shadow equals its own length plus the length of its shadow at noon, Maghrib begins at −1°, and Isha begins at −18°. For Asr, the solar altitude at Asr time was first calculated, followed by a simulation of the Sun's altitude to determine its beginning time. Meanwhile, the other four prayer times can be simulated directly using Stellarium software without prior calculation. The times presented are in local mean time (LMT).

The beginning times of prayer simulated using Stellarium software on 19 June 622, with the Sun's maximum declination value of +23°36′52″, are as follows.

Table 1. The beginning times of prayer in the Arabian Peninsula and higher-latitude regions when the Sun was at the northern solstice during the Prophet's era, based on local time.

| No | City | Fajr | Dhuhr | Asr | Maghrib | Isha |
|---|---|---|---|---|---|---|
| 1. | Al Bahiyah 12°37'59,90N 43°56'17,25"E | 04:13:07 | 11:59 | 15:25:17 | 18:28:51 | 19:43:55 |
| 2. | Mecca 21°25'22,38"N 39°49'25,17" E | 03:49:24 | 11:59 | 15:18:57 | 18:46:24 | 20:07:40 |
| 3. | Turaif 31°39'57,88"N 38°39'48,49"E | 03:11:27 | 11:59 | 15:38:7 | 19:10:26 | 20:45:42 |
| 4. | Istanbul, Turkey 41°00'29,66"N 28°58'42,09"E | 02:15:17 | 11:59 | 15:59:42 | 19:38:53 | 21:41:51 |
| 5 | Gukovo, Russia 48° 3' 43.63"N 39° 56' 7.80"E | 00:29:02 | 11:59 | 16:14:39 | 20:08:20 | 23:28:13 |

Table 1 above shows the beginning times of prayer in three cities located within the Arabian Peninsula and two cities outside the Arabian Peninsula with higher latitudes. The data were obtained from simulations during the Prophet's era in 622 CE, when the Sun was at the northern solstice. Based on the prayer times presented in Table 1, several characteristics of the beginning times of prayer can be observed, ranging from low-latitude to high-latitude locations. These observations apply only to locations in the Northern Hemisphere when the Sun is at its northernmost declination. First, the beginning of Fajr occurs earlier in higher-latitude regions of the Northern Hemisphere according to local time. The opposite occurs for the beginning of Maghrib and Isha. Meanwhile, the beginning of Dhuhr occurs at the same local time. As for Asr,


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the greater the difference between the latitude of the location and the Sun's declination, the later the beginning of Asr occurs according to local time.

The beginning times of prayer at the same locations on 19 December 622, with the Sun's maximum declination value of −23°37′, are as follows.

Table 2. The beginning times of prayer in the Arabian Peninsula and higher-latitude regions when the Sun was at the southern solstice during the Prophet's era, based on local time

| No | City | Fajr | Dhuhr | Asr | Maghrib | Isha |
|---|---|---|---|---|---|---|
| 1. | Al Bahiyah 12º37'59,90N 43º56'17,25"E | 05:04:19 | 12:02 | 15:17:43 | 17:47:12 | 18:59:19 |
| 2. | Mekah/Kakbah 21°25'22,38"N 39°49'25,17" E | 05:17:42 | 12:02 | 15:05:45 | 17:30:39 | 18:46:0 |
| 3. | Turaif 31º39'57,88"N 38º39'48,49"E | 05:32:36 | 12:02 | 14:45:49 | 17:08:35 | 18:31:05 |
| 4. | Istanbul, Turki 41º00'29,66"N 28º58'42,09"E | 05:46:24 | 12:02 | 14:20:35 | 16:43:16 | 18:17:17 |
| 5 | Gukovo, Russia 48° 3' 43.63"N 39° 56' 7.80"E | 05:57:36 | 12:02 | 13:55:23 | 16:18:12 | 18:06:06 |

Based on the prayer times presented in Table 2, several characteristics of the beginning times of prayer can be observed, ranging from low-latitude to high-latitude locations. These observations apply only to locations in the Northern Hemisphere when the Sun is at the southern solstice. First, the beginning of Fajr occurs later in higher-latitude regions of the Northern Hemisphere according to local time. The opposite occurs for the beginning of Maghrib and Isha. Meanwhile, the beginning of Dhuhr occurs at the same local time. As for Asr, the greater the difference between the latitude of the location and the Sun's declination, the earlier the beginning of Asr occurs according to local time.

## F. Significances of Arabian Peninsula's Lattitude in Prayer Times Formulation

Based on the calculations of prayer times in cities across the Arabian Peninsula during the Prophet's era, it can be observed that the Arabian Peninsula was a region where the apparent motion of the Sun and the occurrence of dawn proceeded normally throughout the year. There are no hadith reports or accounts from the Companions that mention difficulties in identifying prayer times during that period. This differs from other regions of the world. The farther north a region is located, the more irregular these phenomena become. Such irregularities are indicated by various phenomena, for example, the extremely short intervals between two prayer times at certain times of the year, as occurs in Istanbul, Gukovo, and other high-latitude countries. In Gukovo, for instance, the beginning of Isha occurs shortly before midnight (at 23:28:13 LMT), while Fajr begins very early (at 00:29:02 LMT) when the Sun is at the northern solstice, resulting in a very short interval between the two prayer times. The most extreme condition occurs in higher-latitude regions or polar areas, where the astronomical signs indicating prayer times disappear entirely during certain months.

The differences in the characteristics of the apparent motion of the Sun and the appearance of dawn, which are determined by geographical latitude, indicate that Islamic law was revealed in an ideal location. This implies that the formulation of prayer times established by the Prophet Muhammad was supported by the geographical conditions of the place where Islam was revealed. At higher latitudes, such as Istanbul, the astronomical indicators for prayer times remain generally observable throughout the year. However, there are periods when the


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appearance of the Sun and dawn becomes less ideal, for example, on 19 June 622, when the beginning of Fajr occurred very early (at 02:15:17) and the beginning of Isha occurred very late (at 21:41:51). At the same time, the interval between the beginning of Fajr and the beginning of Maghrib was extremely long, which affected the practice of fasting. Such conditions did not occur in the Arabian Peninsula, particularly in Mecca, which is relatively close to the equator.

Based on its latitude, Mecca can be regarded as the most ideal location for the formulation of prayer times compared with Al Bahiyah and Turaif. This indicates that the latitude of Mecca also provides advantages over other regions with different latitudes within the Arabian Peninsula. The first advantage is that Mecca's relatively lower latitude (compared with Turaif) results in more ideal prayer times, particularly when the Sun is at the northern solstice. This is demonstrated by the beginning of Fajr in Turaif (03:11:27), which occurs much earlier than in Mecca (03:49:24). At the same time, the beginning of Isha in Turaif (20:45:42) occurs later than in Mecca (20:07:40). These differences inevitably influence human activities and daily routines.

Mecca's latitude, which is not too close to the equator, also provides advantages in facilitating the identification of prayer times. This indicates that Mecca possesses a distinctive characteristic, as its climate supports the ease of observing the beginning times of prayer, particularly in relation to the observation of dawn. Research by Ribeiro et al. shows that the highest solar radiation occurs at latitudes around 20°, in both the Northern and Southern Hemispheres (Ribeiro et al., 2018). In low-latitude regions close to the equator, such as Al Bahiyah (and Yemen in general), one of the climatic characteristics is the high concentration of water vapor in the atmosphere. According to Suryatna (1995), as cited in Machzumy (2018), the region between 10° N and 10° S latitude is an area characterized by abundant rainfall (Machzumy, 2018). Al Bahiyah, located at a latitude of 12°37′59.90″ N, is relatively close to the equator. Regions situated around the equator are commonly known as having an equatorial climate, which is characterized by frequent rainfall (Obiero & Onyando, 2013). Rainfall and cloud accumulation affect the clarity of the sky. Under conditions of frequent rainfall, the visibility of dawn will be disrupted.

As occurs in Indonesia, Muslim astronomers continue to have different opinions regarding the beginning of Fajr prayer time. Differences in observation locations have also produced varying findings. In eastern Indonesia, such as Kupang, atmospheric conditions are relatively clearer than in western regions. Based on observations conducted by the team of the Ministry of Religious Affairs of the Republic of Indonesia in Kupang in 2022, dawn could already be observed when the Sun was at an altitude of 20°–19° below the horizon (Ministry of Religion of Indonesia, 2022). Meanwhile, in western regions of Indonesia, such as North Sumatra, Solo, and Yogyakarta, findings indicate that dawn cannot yet be identified when the Sun is at an altitude of −20° below the horizon (Ritonga, 2020). The factors influencing the ease or difficulty of observing dawn are also affected by weather conditions, such as rainfall and cloud cover. In Indonesia, dawn observations can only be conducted effectively during the dry season (Ministry of Religion of Indonesia, 2022).

Based on the discussion above, it can be emphasized that the latitude of the Arabian Peninsula, particularly Mecca, which is not too close to the equator, provides advantages for the ease of observing solar shadows and dawn. Furthermore, Mecca's location, which is not situated too far south within the Arabian Peninsula, also contributes to different climatic conditions. In addition, climate theory indicates that rainfall decreases as a region's distance from the equator increases. This means that the closer a region is to the equator, the higher its annual rainfall tends to be. Previous studies have shown that the southern part of the Arabian Peninsula receives more rainfall than the northern part (Brown et al., 1989; Patlakas et al., 2021). This demonstrates that latitude has a real and significant influence on the observation of prayer times during the


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Prophet's era, when the determination of prayer times could only be based on the apparent position of the Sun and the visibility of dawn.

## G. The Link between Islam and Arab Based on Prayer Times Formulation

The prayer ritual, whose times were formulated based on the apparent motion of the Sun and the visibility of dawn, provides important reflections for Muslims and humanity in general. Such reflections are essential for describing the link between Arabia and Islam from the perspective of 'ilm al-falak (Islamic astronomy). Renan's theory, which argues that Islam and other monotheistic religions are connected with desert environments, is not entirely incorrect. This is because the Arabian Peninsula possesses geographical characteristics dominated by desert landscapes. Likewise, Gibb's theory, which highlights the link between the characteristics of Arab society (as traders) and the prayer ritual, suggests that Islam spread easily across the world because prayer could be observed by people several times a day.

However, the relationship between Islam and Arabia can also be understood from another perspective that has been scientifically demonstrated. The regularity of prayer times, which is influenced by geographical latitude, indicates that the latitude of the Arabian Peninsula made a significant contribution to the formulation of prayer times as an essential component of Islamic law. Therefore, the link between Islam and Arabia cannot only be explained through geographical conditions (such as the desert environment) and social characteristics (such as a trading society), but also through its astronomical location, which was ideal for the formulation of Islamic religious practices.

Accordingly, Heinz's view that the five daily prayers formulated by Muhammad were inspired by Zoroastrian, Jewish, and indigenous Arabian religious traditions has certain limitations, because the formulation of the five daily prayers in Islam is based on the observable phenomena of the Sun and dawn, rather than on the ritual practices of Zoroastrian followers.

## CONCLUSION

Based on this study, it can be concluded that the significance of the latitude of the Arabian Peninsula in the formulation of prayer times consists of two aspects. First, the latitude of the Arabian Peninsula facilitates the identification of the signs indicating prayer times. Second, the position of the Arabian Peninsula, which is not too close to the equator, results in fewer occurrences of clouds and rainfall associated with equatorial climatic factors. Theoretically, this condition supports the visibility of dawn. Based on the analysis of the latitudinal positions of the five cities examined in this study, Mecca represents the most ideal location compared with the other cities. This is due to its latitude, which is neither too close to the equator nor too close to the poles. This study reveals that Islamic teachings (sharia) were revealed in a specific astronomical setting with distinct characteristics, not only in terms of geographical conditions or social characteristics but also in terms of an ideal astronomical location.

This study has several limitations. The geographical characteristics of the Arabian Peninsula, such as desert conditions, surrounding seas, and mountain distribution, have not been considered as factors influencing climatic and weather characteristics. In addition, this study has not empirically verified the beginning times of prayer at the examined locations. The validation was based only on historical simulations using software and theoretical analysis rather than factual verification. Therefore, further field observations are required to examine the geographical, climatic, and weather factors of the Arabian Peninsula, with particular focus on the extent to which these factors contribute to the ease of determining the beginning times of prayer.

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