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Using the Central Mosque Coordinates of the Regency or City for Calculations of Prayer Times in the Province of Jambi

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Abstract

This article describes the application of the coordinates of the district/city central mosque in determining the prayer time schedule in Jambi Province. The use of the coordinates of the central mosque in determining the prayer time schedule raises indications of problems if applied to areas with large stretches of territory. This research is a field research with analytical descriptive analysis method. The data obtained is processed through a comparison of prayer time schedules in 11 districts / cities in Jambi province between the calculation base of the central mosque and the calculation base of the westernmost point of the area concerned. The results of this study indicate that the coordinates of the central mosque of the regency / city are used as the basis for calculating the prayer time schedule on the grounds that these mosques are considered representative and represent their respective regions. However, the application of the coordinates of the central mosque has an impact on not covering some areas with a maximum value of 1 minute 52 seconds. This is convincing evidence (qarinah) with the implication of having to make corrections to the use of the markaz of the central mosque of the district/city in the calculation of the prayer time schedule in Jambi province.

Kata kunci : Coordinate, Central Mosque, Markaz, Prayer Times

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A. Introduction

Prayer (fardu) is an obligatory act of worship, the time of which has its own rules. Fiqh scholars agree that the times of prayer are clearly determined by the Qur'an and the Sunnah of the Prophet Muhammad; in fact, almost all fiqh books have a special chapter that talks about mawaqit as-prayer. From this, it is clear that the initial concept of the time of prayer is the result of the ijtihad of the scholars in interpreting the verses of the Qur'an and the hadiths related to the time of prayer[1].

Basically, the determination of prayer times is based on the daily phenomena of the sun as a result of the apparent daily movement of the sun. These phenomena are such as dawn, sunrise, dusk, dawn or the length of the shadows that result from the position of the sun. Thus, it can be said that prayer times can be known based on the orbit of the sun or the determination of the position of the sun in relation to the earth[2].

Prayer schedules are created using calculations based on the movement of the sun, which is assumed to be relatively constant every day of the year. The accuracy of the calculation of prayer times is largely determined by the data used. One of the important data in calculating prayer times is the coordinates of the place as a differentiator for prayer times in different places.

Coordinates for calculating prayer times that are currently being developed use regency or city markaz bases, which can be seen from the coordinates used for prayer times in different regions. However, once the prayer schedule has been calculated on the basis of the coordinates of each regency or city, the next problem that arises is the selection of the coordinates of the place to be used as a reference. Meanwhile, an error in determining the coordinates of a city or regency when calculating prayer times will affect the resulting prayer schedule that does not cover the entire regency or city.

The safeguard against this problem is to add the ihtiyath time. However, this safety measure will also not be effective if it is applied to areas that are too large; even if ihtiyath is implemented, it will still result in areas that are not covered in the resulting prayer schedule.

The author found this situation in the province of Jambi, which has regencies or cities with different areas. In this case, the coordinates of the mosque in the regency or city centre are used as the calculation data. This is not a problem when applied to areas with a coverage area that is not too large,

[1] Susiknan Azhari, *Pembaharuan Pemikiran Hisab di Indonesia (Studi Atas Pemikiran Saadoe'ddin Djambek)*, (Yogyakarta: Pustaka Pelajar, 2002), p. 25

[2] Agrafi, A. Mukri, *Aplikasi Hisab Rukyat*, (t.tp, 2002), p. 53.

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such as the city of Jambi, but problems arise when applied to areas with a large coverage area.

Based on the initial research, the authors used Google Earth to locate the coordinates for West Tanjung Jabung regency, one of the regencies in Jambi province with an area of approximately 4,649.85 km22 . The coordinates used to calculate the prayer times in this regency are the coordinates of the mosque in the centre of Kuala Tungkal (0□ 49`9,58"S dan 103□ 27`50,13"E), which is at the eastern end of the regency. Meanwhile, at the western end of the regency, there are still villages such as Lubuk Kambing village (1□ 18`44,77"S dan 102□ 50` 11,67"E). According to the author's calculations of prayer times at the two coordinates, there is a difference of up to 3 minutes, as shown in the following table of prayer times in June:

Table 1. Prayer Schedule for June with the Coordinates of the Kuala Tungkal Mosque

Date	Fajr	Dhuhr	Asr	Maghrib	Isha
01	4.40	12.05	15.30	18.08	19.22
02	4.40	12.05	15.30	18.08	19.22
03	4.40	12.06	15.30	18.09	19.22
04	4.40	12.06	15.31	18.09	19.22
05	4.41	12.06	15.31	18.09	19.23

Table 2. Prayer Schedule for June with Lubuk Kambing village coordinates

Date	Fajr	Dhuhr	Asr	Maghrib	Isha
01	4.44	12.08	15.32	18.10	19.23
02	4.44	12.08	15.33	18.10	19.24
03	4.44	12.08	15.33	18.10	19.24
04	4.44	12.08	15.33	18.10	19.24
05	4.44	12.08	15.33	18.11	19.24

From the table above, it can be seen that the difference in prayer times is such that the 2 minute ihtiyath applied for prudence will still not be able to accommodate the difference in prayer times in the two locations, as the difference itself reaches 3 minutes. Based on this initial research, the prayer schedule generated from the coordinate data of the mosque in Kuala Tungkal is not relevant for use in the village of Lubuk Kambing, which has implications for the coordinates of the mosque used as data for the initial calculation of prayer times for West Tanjung Jabung regency, which are also irrelevant for use.

Based on the above facts, it is important to conduct research on regencies or cities in Jambi province related to the coordinates of mosques in the regency or city centre used for calculating prayer times, that is, related to the method of implementing these coordinates and their accuracy in calculating prayer times.

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B. Research Method

This research focuses on coordinate problems in determining prayer times, so the most appropriate type of research is field research. Meanwhile, in terms of analytical method to be used, this research uses a descriptive analytical analysis method, which will try to explain the implementation of mosque coordinates in the regency or city centre in calculating the initial prayer times of regencies or cities in Jambi province along with its accuracy.

Data collection techniques in this study were conducted through interviews, observation and documentation. The data obtained was then processed in such a way that the data analysis was carried out by comparing the prayer schedule data in 11 regencies/cities in Jambi province using the calculation base of the central mosque with the calculation base of the westernmost point of the area concerned.

The above analysis then shows the coverage of the western area of an area using the coordinates of the central mosque, so that data and facts related to the effectiveness of using the coordinates of the central mosque as the basis for calculating prayer times are obtained.

The results of this study have also been analysed in terms of theories related to prayer times.

1. Accuracy of Prayer Times

The accuracy of a calculation is certainly an important thing in determining the time of prayer. Accuracy is very much dependent on the method and data used in the calculation. Regarding the astronomical data of prayer times, an accuracy of 0.01 degrees is sufficient for calculating the position of the sun in order to obtain the times of sunrise, sunset and transit. The reason for this is obvious: the apparent diurnal motion of the celestial sphere corresponds to a rotation of more than one degree in a four-minute time interval, and an error of 0.01 degrees in the position of an object would result in an error of only 0.04 minutes (approximately) in the calculation of its sunrise and sunset times. Using hundreds of periodic components in the calculations to get the position of the Sun to within 0.01 would be a waste of effort and computer processing time on this issue[3].

2. The Concept of *Ihtiyath* in Prayer Times

Ihtiyath is a safety measure in determining prayer times by adding or subtracting time so that it does not precede the start of the prayer time or exceed the end of the prayer time. The calculation experts differ in determining the time for Ihtiyath, some set 2 minutes, 3 minutes or 4 minutes.

[3] Meeus, Jean, *Astronomical Algorithms*, (Virginia: IncWillman-Bell, Inc, 1991), p. 17.

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The commonly used opinion is 2 minutes for Ihtiyath time[4].

The Ministry of Religious Affairs of the Republic of Indonesia stated that Ihtiyath is a safety measure in determining the time of prayer by adding or subtracting time so that it does not precede the start of the prayer time and does not exceed the end of the prayer time[5].

The most representative ihtiyath for the validity of prayer times are regencies and cities whose range of the markaz for calculating the prayer schedule with the westernmost point does not exceed 55.54 km (2 minutes of ihtiyath). The use of 2 minutes of Ihtiyath time for a larger area will certainly result in some areas that are still included in the administrative area of that area not being considered. The solution offered is to increase the time of Ihtiyath according to the size of the area, but this also has its own implications, namely the greater the delay in prayer times for areas that are in the eastern part of the calculation markaz.

3. Area of Applicability of Prayer Times

The coordinates themselves are also important data for calculating prayer times. Coordinates are the difference between one place and another. However, when calculating prayer times, for convenience and to avoid problems in the field, regency or city prayer time schedules are implemented. This was done by determining a coordinate in a regency or city to be used as data for calculating prayer times for the entire regency or city.

Determining Wilayatul Hukmi prayer times based solely on mathematical calculations will, of course, also be very difficult. The only way is to make adjustments to existing administrative areas and clear boundaries, and the most logical is regencies/cities.

4. Prayer times for Markaz coordinates calculations

Talking about the area is certainly inseparable from the problem of geographical coordinates. The geographical coordinates of an area play an important role in calculating prayer times and determining the time of Ihtiyath. The geographical coordinates, in this case the longitude (λ) and latitude (Φ) used, will affect the results of the initial calculation of the prayer time for a place[6].

The position of objects on the Earth's surface in geographic coordinates is defined by latitude and longitude. Latitude is a vertical line that measures the angle between a point and the equator[7]. While longitude is a

[4] The Ministry of Religious Affairs of the Republic of Indonesia, *Beginning Determinatio of Prayer Times*, (Jakarta:Directorate General of Islamic Guidance – Director General of Binbapera, 1994), p. 9

[5] The Ministry of Religious Affairs of the Republic of Indonesia, *Beginning Determinatio of Prayer Times*, p. 10.

[6] Muslih, M, *Penerapan Lintang dan Bujur*.., p. 46

[7] Susiknan Azhari, *Ensiklopedi Hisab Rukyat*,

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horizontal line that measures the angle of a point with the zero point of the earth, which is Greenwich in London, United Kingdom.[8]. The units are degrees, and can also be written in DMS (Degree Minute Second) with 1 degree = 60 minutes and 1 minute = 60 seconds.

C. Result and Discussion

Results

According to Rahmadi, the coordinates used to calculate prayer times in Jambi province have changed several times; before 2015, the coordinates used were data from the Geospatial Information Agency. The Ministry of Religious Affairs started to socialise the data of the central coordinates on 1 October 2013. During the Ministry of Religious Affairs of the Republic of Indonesia Reckoning Work Meeting held at Sempur Park Hotel Bogor on April 3-5, 2014, it was agreed to standardize rukyat reckoning (recognition of prayer times and qibla direction)[9]. These coordinates are included in books on astronomy published by the Ministry of Religious Affairs of the Republic of Indonesia, such as the Almanac of Hisab Rukyat and the Pocket Book of Hisab Rukyat. The coordinates used are the coordinates of the centre of the regency/city in question. This is known by tracking each coordinate using Google Earth.

However, the application of the midpoint of the region into the prayer time calculation base has experienced many responses from the regions, especially regions whose midpoints are in locations that have no inhabitants such as mountains, forests or the sea. Among the regions that have problems in applying the midpoint of this region is the Riau Islands, which if the midpoint of the region is applied, it will be located in the ocean without inhabitants, so it is considered not suitable for use as a prayer time calculation headquarters.

In later developments, the coordinates of the centre are no longer used to calculate prayer times. Coordinates (markaz) during prayer times are then determined by stipulations, if a mosque is found in the city or regency capital, then the location is chosen at a representative mosque, if no mosque is found, then the location is placed at the mayor's or regent's office, and if option two is also not possible, then a location with a large population in the city or regency is chosen that has mosques that are considered to be the centres of their respective regions. These mosques are

(Yogyakarta: Pustaka Pelajar, 2008), p. 134.

[8] A. Jamil, *Ilmu Falak (Teori Dan Aplikasi)*, (Jakarta: Hamzah, 2011), p. 10.

[9] Ahmad Izzuddin, "Schedule Guide Imsakiyah (Formulating Standard Imsakiyah Schedules in Central Java). Paper of Imsakiyah Workshop 1436 H, Semarang: Regional Office of the Ministry of Religion, Central Java Province, 19 May 2015, p. 3.

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located in the regional administrative centre (capital). The coordinates in question are as follows

Table 3. Regency/City Central Mosque and its coordinates[10]

Regency/City	Name of Mosque Center	Coordinate
Jambi City	Agung Al-Falah Mosque	1°35'38.77"S 103°36'29.59"E
Kerinci	At-Taqwa Mosque Siulak Mukai	1°58'04.52"S 101°21'22.30"E
Sungai Penuh City	Agung Mosque Pondok Tinggi	2°03'58.28"S 101°23'37.49"E
Bungo	Agung Mosque Muara Bungo	1°28'58.90"S 102°06'54.50"E
Merangin	Al-Hidayah Mosque Bangko	2°04'07.22"S 102°16'19.39"E
Tebo	Agung Mosque Muara Tebo	1°29'19.69"S 102°26'33.30"E
Sarolangun	Al-Falah Mosque Sorolangun	2°18'10.12"S 102°43'27.21"E
Batanghari	At-Taqwa Big Mosque	1°42'41.66"S 103°15'17.16"E
West Tanjung Jabung	Agung Istiqomah Mosque Kuala Tungkal	0°49'09.58"S 103°27'50.13"E
Muaro Jambi	Agung Al-Abror Mosque Sengeti	1°27'15.63"S 103°30'38.62"E
East Tanjung Jabung	Agung An-Nur Mosque Muara Sabak	1°07'38.78"S 103°51'16.18"E

The data on the coordinates of the central mosque in the district/city are also data obtained from the Geospatial Information Agency (BIG). The Ministry of Religious Affairs of the Republic of Indonesia, in cooperation with the BIG, then publishes the latitude and longitude data of districts/cities for the entire territory of Indonesia, including the coordinates of the central mosque of the district or city, which is used as the markaz for calculating prayer times.

Khafid also revealed that these coordinates were obtained through satellite imagery, which is the process of capturing images of mosques that are the centre of an area as a result of satellite imagery taken in space hundreds of kilometres above the earth's surface.

The use of the coordinates of the regency/city central mosque as a markaz in calculating prayer times was chosen on the grounds that the mosque in question is the centre (place of worship) in each region. Therefore, the central mosque of the regency/city is a representation of the mosques located in the outskirts of the regency/city, so that the coordinates can become the basis for calculating prayer times in all geographical areas of the regency/city (shared data from Ismail Fahmi).

The Ministry of Religious Affairs of the Republic of Indonesia, as previously explained, facilitates the calculation of prayer times for areas throughout Indonesia, including regencies/cities in Jambi province,

[10] The area per Regency/City is taken from the Data on Area and Percentage of the Central Bureau of Statistics for Jambi Province, accessed on the jambi.bps.go.id page on September 15th, 2022, at 12.05 WIB. The name of the Regency/City Center mosque and its coordinates are taken from data on the Latitude and Longitude List of Cities throughout Indonesia, submitted during an interview with the Head of Hisab Rukyat Sub-Directorate of the Ministry of Religion of the Republic of Indonesia, on 29-31 August 2022.

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through the prayer time function or the imsakiyah schedule available on the website of the Indonesian Ministry of Religious Affairs' Islamic Community Guidance. Therefore, regions only follow the results of calculations provided by the Centre. Regions are allowed to calculate prayer times for an area that is extended and facilitated in the prayer schedule provided by the Ministry of Religious Affairs of the Republic of Indonesia[11].

Based on the above explanation, it can be said that Jambi Province refers to the Ministry of Religious Affairs of the Republic of Indonesia in terms of prayer times, i.e. the prayer schedule provided by the Islamic Community Guidance. So that the Regional Office of the Ministry of Religious Affairs of Jambi Province or the Hisab Rukyat Team have no authority in determining prayer times in Jambi Province, this case of course explains that the coordinates/markaz used are also the central authority. The regions still have a role to play in providing input or suggestions on matters relating to the use of prayer schedules in their respective regions, they can even make changes to prayer schedules if matters relating to inaccurate prayer schedules are found in an area.

The modification of the Islamic Community Guidance Prayer Time Schedule was carried out in Jambi Province, namely when formulating the Imsakiyah Ramadhan in 1442 H/2021 M, because data was obtained regarding the inaccuracy of the Imsakiyah schedule for West Tanjung Jabung Regency, so it was specifically agreed for that Regency to add one minute to the Ihtiyath time. However, for the following years, this addition will not be enforced and the Imsakiyah schedule will be implemented as stated on the Bimas Islam website.

Discussion

Prayer time from the perspective of astronomy is an interpretation of Syar`i arguments for scientific aspects. Prayer times in the Qur'an and Hadith are related to natural phenomena, namely phenomena caused by the movement of the sun. These phenomena are then translated by astronomy to make calculations (hisab) of the phenomena for each prayer time, so that the prayer time can be known without directly seeing the natural phenomena that are a sign of the beginning of the prayer time. This makes it easier for Muslims to perform the prayer itself.

According to A. Fadlil et al, a good prayer schedule is one that is calculated specifically for a city, and not one that is the result of a conversion from a list of regional

[11] Interview via Whatsapp with Ismail Fahmi, 29-31 August 2022.

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corrections from other city calculations. The prayer schedule can be said to be good and closer to accurate if several criteria are met, such as determining the exact coordinates to be used as a reference, the calculation formula used, and the ihtiyath value as a tolerance value in the calculation results [12].

Determining coordinates in calculating prayer times is important because coordinates/markaz are the difference between prayer times in one area and another. Determining the coordinates will also affect the coverage of an area or a particular area, bearing in mind that the applicable area during prayer times (wilayatul hukmi) is one regency/city.

Jambi Province, as explained above in determining the coordinates/markaz for calculating prayer times based on the regency/city central mosque with the implementation of ihtiyath 2 minutes for Fajr, Asr, Maghrib and Isha prayers, 3 minutes specifically for Zuhr prayers[13]. The use of regency/city mosque coordinates will certainly not be a problem in areas with a small east-west stretch, but will have a great potential for inaccuracy in areas with a large east-west stretch.

Security in the form of ihtiyath 2 minutes will also not be very helpful in areas with large distances. Perhaps anticipating the Ihtiyath time can be used for cities/regencies that are not too large, if the area is large then the Ihtiyath time cannot include prayer time schedules for certain cities/regencies and requires a very large Ihtiyath time. Thus, if combined with the explanation in the previous section, the most representative ihtiyath for the validity of prayer times is the city regency that the range of markers for calculating prayer times with the westernmost point does not exceed 55.54 km (ihtiyath 2 minutes).

The implementation of ihtiyath as a security measure against special prayer times for Jambi province is also heavily influenced by the area of each regency/city in Jambi province. In this case, the most influential factor is the distance or difference in coordinates between the markaz used and the area assumed to be the westernmost point of the regency/city in question. It is therefore necessary to know the difference between the coordinates of the regency/city central mosque as the calculation markaz and the coordinates of the westernmost point as a comparison of the coverage of prayer times based on the difference in these coordinates.

[12] A. Fadlil, Sunardi, and N. Darajat, Muhammad, "Sistem Informasi Arah Kiblat Dan Jadwal Waktu Shalat Di Kota-Kota Besar Di Indonesia," in Prosiding Interdisciplinary Postgraduate Student Conference 1, 2016, p. 104-109.

[13] Bimas Islam Kemenag RI, *Ephemeris Hisab Rukyat 2022*, (Jakarta: Bimas Islam, 2022), p. 417-420

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Table 4. The differences between the coordinates of the Central Mosque and the West Point of the Regency/City in Jambi Province [14]

Regency /City	Coordinate	Regency /City	Coordinate
City Jambi	1°38'22.56"S 103°32'31.81"E	3’ 57,77”	2’ 43,79’’
Kerinci	2°15'51.51"S 101°17'21.36"E	4’ 0,93”	17’ 46,99”
Sungai Penuh	2°04'50.17"S 101°22'33.1"E	1’ 4,38”	0 51,89”
Bungo	1°42'23.56"S 101°27'38"E	39’ 16,5”	13’ 24,66”
Merangin	2°30'51.51"S 101°33'31.01"E	42’ 48,37”	26’ 44,29”
Tebo	1°29'19.69"S 102°26'33.30"E	36’ 40,42”	25’ 43,09”
Sarolangun	2°18'10.12"S 102°43'27.21"E	38’ 11,8”	26’ 17,59’
Batang hari	1°42'41.66"S 103°15'17.16"E	43’ 21,13”	10’ 37,72”
West Tanjung Jabung	0°49'09.58"S 103°27'50.13"E	48’ 25,29”	18’ 47,03”
Muaro Jambi	1°27'15.63"S 103°30'38.62"E	11’ 13,27”	27’ 32,95”
East Tanjung Jabung	1°07'38.78"S 103°51'16.18"E	28’ 33,31”	7’ 4,29”

The table above shows the difference in coordinates between the regency/city mosque markers used to calculate prayer times and the coordinates of the westernmost point for comparison. From the table above we can see that the largest difference in longitude is found in West Tanjung Jabung regency with a value of 48' 25.29", while the largest difference in latitude is found in Muaro Jambi regency with a value of 27' 32.95".

The resulting difference is then processed to see the distance between the regency/city mosque markers used as the basis for calculating prayer times, with the coordinates of the westernmost point for comparison. As a first step, we will look at the distance between the longitude of the regency/city central mosque as a calculation markaz with the longitude of the westernmost point to see the coverage of prayer times where the longitude of the area is large data. This is done on the assumption that the further west the location of a place, the later the prayer time.

The above data is then used to estimate the ihtiyath value in each region, so that local prayer times are not taken into account when the regency/city central mosque is used as the markaz of calculation. The data can be seen in the following figure:

[14] The area per Regency/City is taken from the Data on Area and Percentage of the Central Bureau of Statistics for Jambi Province, accessed on the jambi.bps.go.id page on September 15th, 2022, at 12.05 WIB. The name of the Regency/City Center mosque and its coordinates are taken from data on the Latitude and Longitude List of Cities throughout Indonesia, submitted during an interview with the Head of Hisab Rukyat Sub-Directorate of the Ministry of Religion of the Republic of Indonesia, 29-31 August 2022.

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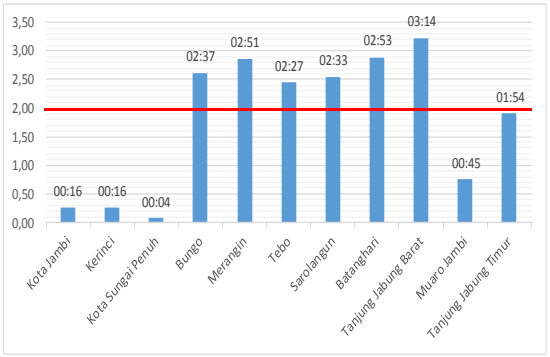

Figure 1. Ihtiyath Coverage of Prayer Time Schedules with the Headquarters of the Regency/City Central Mosque in Jambi Province[15]

The figure above shows that based on the threshold line of 2 minutes of ihtiyath used to secure prayer schedules in Jambi province, there are several regencies/cities where the use of 2 minutes of ihtiyath is still unable to cover the westernmost areas available in each regency/city. There are 6 regencies/cities that still have prayer times that do not cover the entire area. The regencies/cities are Bungo, Merangin, Tebo, Sarolangun, Batanghari, West Tanjung Jabung, Muaro Jambi and East Tanjung Jabung. The non-coverage ranged from 27 seconds to 1 minute 14 seconds. Calculating the area not covered by ihtiyath security in the 6 regencies/cities, the following data are obtained:

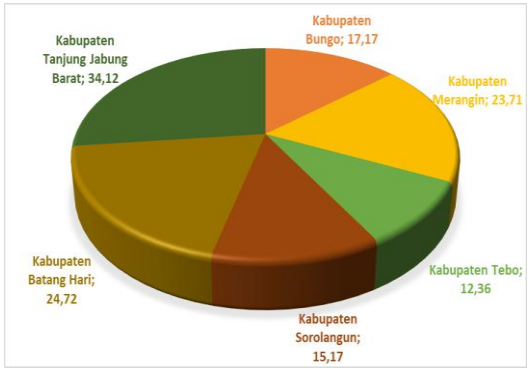

Figure 2. Size of Areas that are Not Covered by Ihtiyath Time (km) [16]

The above data shows that the implementation of the coordinates of the regency/city central mosque in the prayer schedule is still not accurate and effective, especially in 6 regencies/cities with large area coverage. Through the analysis conducted, it is known that the 6 regencies/cities have large areas in the western part that are not covered by the prayer time schedules based on the calculation of the regency/city central mosque. This area has a distance that varies depending on the length of the area and the distance to the markaz coordinates used, ranging from 12.36 km (Tebo regency) to 34.12 km (West Tanjung Jabung regency). This means that in the 6 urban regencies, there are areas in the western part ranging

[15] The coverage of ihtiyath in each region is determined by calculating the amount of ihtiyath per area. In this case, it is done by means of the distance value of the coordinates of the regency/city center mosque divided by the range of motion of the Sun per minute.

[16] Data processing of the area not covered by Ihtiyath Time above is done by converting the remaining uncovered ihtiyath (previous data) into the form of the length of the area in km.

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from 12.36 km to 34.12 km that are not covered by the prayer schedule based on the regency/city central mosque.

The above data analysis is based on calculations by including the ihtiyath values used. The calculation is also based on the difference in longitude, which is assumed to affect the difference in prayer times between the calculation markaz and the coordinates of the area at its westernmost point. This means that the available prayer schedule, especially in the 6 regencies/cities of Jambi province, does not cover the westernmost point of their respective regions.

In general, the above data provides an illustration of the non-fulfilment of regency/city wilayatul hukmi aspects in prayer time schedules in 6 regencies/cities in Jambi Province, but the results of the above data analysis cannot be immediately used as a justification that the schedule of prayer times in Jambi Province is not accurate. However, further analysis needs to be carried out by comparing the prayer times based on the markaz of the mosque in the regency/city and the coordinates of the westernmost point, so that the previous analysis can be strengthened and perhaps even corrected, as the above analysis was carried out with the aim of providing a rough general picture.

The extended analysis shows that there are 4 regencies/cities with valid prayer times covering the entire region, the 4 regencies/cities are Jambi City, Kerinci Regency, Sungai Penuh City and Muaro Jambi Regency. However, there are still 3 areas where the prayer schedule does not cover the westernmost area, these are Bungo, Batang Hari and West Tanjung Jabung Regencies. Meanwhile, the other 5 regions show fluctuating comparative data based on the daily prayer schedule in each region, these are Merangin Regency (21.1% valid), Tebo (39.7% valid), Sarolangun (36.3% valid), Batanghari (20% valid) and Tanjung Jabung Timur (76.9% valid). When all the comparative data is accumulated over a period of 50 years, consisting of 84736 prayer time data, the percentage validity of prayer time in Jambi province is 54%. Of course, this is based on the fact that the schedule of prayer times based on the regency/city central mosque as the calculation base can only cover 52% of the westernmost point of the regency/city in Jambi province.

The comparison of prayer times above also shows that the prayer time schedule used now only covers areas that have a relatively small area or stretch, or areas where the regency/city central mosque is located close to the western point of their respective regions. This condition is shown

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by the data above that the largest difference in prayer time is found in West Tanjung Jabung regency with an average value of 03 minutes 14 seconds, where in this regency the distance between the central mosque and the coordinates of the westernmost point is 89.68 km, which is the farthest among 11 regencies/cities in Jambi province. Meanwhile, the smallest difference was found in the city of Sungai Penuh with an average difference of 0 minutes 4 seconds. It is not known that the distance from the central mosque to its western point is 1.99 km, which is the shortest distance among 11 regencies/cities in Jambi province. This certainly reinforces the results of the previous analysis, which was based on the longitude difference of the markaz coordinates used with the reference coordinates.

The validity of the prayer schedule based on the comparative analysis carried out above shows 5 regencies/cities where the difference in comparison is fluctuating, i.e. there is a distribution of data indicating validity and other data indicating invalidity, which means that some of the compared prayer time data show the coverage of the prayer schedules used, but others show that the schedule does not cover its westernmost point.

After carrying out a detailed analysis of the distribution of prayer times, it was found that 5 regencies/cities, as previously explained, had some prayer times that covered the entire region, but some did not. What's interesting is that in these 5 regencies/cities, the Zhuhr schedule is in the safe category, this is of course due to the Ihtiyath Zhuhr time which reaches 3 minutes. However, the other prayer schedules are still insecure even though they have used Ihtiyath 2 minutes.

Another interesting condition is seen in East Tanjung Jabung regency, where the majority of the distribution of prayer times compared can be said to be valid, but there is still about 23.1% of the distribution of prayer time data that does not cover the western part of the region. Looking closely, East Tanjung Jabung Regency has an area of about 5445 km2 with an elongated position from east to west, which means that it is wider than its neighbouring West Tanjung Jabung Regency, which was previously known to be unable to cover the western point of the area. The question that arises is related to the results of the analysis which shows that the coverage of prayer times for East Tanjung Jabung Regency reaches 76.9%. This question can be answered by looking at the location of the actual markaz centre of the regency/city centre mosque, which is only a short distance of 52.88 km

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from its westernmost point. The distance of 52.88 km, if converted into time, will only take 1 minute 54 seconds of ihtiyath time, but other aspects that determine prayer times such as sun dates, altitude and others are also taken into account in calculating prayer times, so there is still an accurate distribution of prayer times at certain times that cannot cover the prayer times in the westernmost area of East Tanjung Jabung Regency.

Furthermore, the above facts emphasise that the prayer schedule based on calculations in the form of the regency/city central mosque can only cover the entire relatively small regency/city area, these are Jambi City, Sungai Penuh, Kerinci Regency and Muaro Jambi. Conversely, for areas that are large and the distance from the central mosque to the westernmost point is relatively long, the prayer schedule will not be able to cover the westernmost point of the area, these areas are Bungo and West Tanjung Jabung Regencies. Meanwhile, there are 5 other regencies/cities that have a comparative distribution of prayer schedules that are sometimes valid and sometimes invalid, or it can be said that at certain times the prayer schedule can cover the entire region, but at other times the prayer schedule cannot cover the entire area.

The following is an example of a comparison of prayer times based on the regency central mosque based on the coordinates of the westernmost point of the area in West Tanjung Jabung regency (not covering the westernmost area), Tebo (covering part of the time) and Jambi City (covering the entire area), this comparison is intended to show an overview of the distribution of differences in prayer times at both points in each area that are visible at certain prayer times. In this case, taking the Fajr prayer time as an example, the comparative description is as follows:

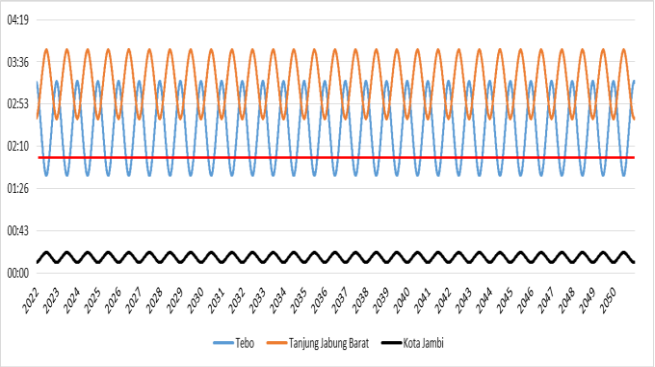

Figure 3. Graph of Difference in Fajr Prayer Time at the Markaz of the Central Mosque and the West Point of Tebo Regency, West Tanjung Jabung and Jambi City

The red line shows the 2-minute ihtiyath threshold used as a safety measure for prayer times. From the figure above, the distribution of the difference in prayer times at 2 points in each regency/city area, with an ihtiyath threshold of 2 minutes, can be seen that the Jambi city prayer schedule can be said to be valid and to cover the entire area because the spread of prayer time differences

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produced is below the ihtiyath threshold. This is slightly different from the graph showing the difference in prayer times in Tebo Regency, where the majority of the prayer time data still shows a significant difference in prayer times.

At the western point of the area, with a percentage of 70.14%, only a small portion can be classified as safe and covers the western point. Meanwhile, in West Tanjung Jabung regency, the distribution of differences in prayer times is shown, which as a whole is outside the safe limit (ihtiyath 2 minutes). This means that the Fajr schedule in this regency cannot cover the western point of the area. Almost the same conditions were shown for other prayer times in 11 regencies/cities of Jambi province.

The results of the analysis in this study indicate that there are several regencies/cities where the applicable prayer schedule cannot cover the entire area, especially the area at the westernmost point of the region. This depends on the size of the area and the distance between the central mosque and the western point of the area concerned. The size of the area that cannot be covered in each region also varies, ranging from 12.36 km to 34.12 km. In terms of time, the largest gap in prayer time between the two points is 1 minute 52 seconds.

In principle, of course, the value of 1 minute 52 seconds is not too large and does not have a significant impact on the practice of prayer times carried out by the community. Although scientifically the prayer time can be said to be accurate if it has an error interval of no more than 0.01 degrees, which gives an error of only 0.04 minutes (approximately), this means it doesn't reach one minute. Using hundreds of periodic components in calculations to obtain the Sun's position with an accuracy of 0.01 minutes would only be a waste of computer processing time and energy for this problem (Jean Meeus, 1991). Therefore, in a scientific context, the value of 1 minute 52 seconds cannot be said to be within the exact tolerance limits.

The scientific aspect certainly cannot be used as a standard in the basis of the implementation of worship, because it will make it difficult, and Islam itself in its Shari'ah principles places aspects of convenience in the implementation of its Shari'ah, meaning that all kinds of legal burdens are stipulated for the good of the soul and its sanctity, never to be burdensome (Hasbi Ash -Shiddieqy, 2001). However, the principle of facilitation in Islamic law must still be carried out in the right way, in other words, the legal burden must be carried out

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with maximum effort by a Muslim. This matter is based on a rule of fiqh:

ما لا يمكن الاحتراز عنه فهو معفو عنه[17]

"Everything that impossible avoided it, is forgiven"

The above rule implies an obligation to make the best effort, which can be seen from the phrase " ما لا يمكن". There are conditions that make it difficult to carry out a lawsuit, and if after maximum efforts it still cannot be fulfilled, then it is forgiven. In the previous discussion, it was explained that prayer times are fixed times and one of the valid conditions for prayer is to perform it at a fixed time. The accuracy of prayer times is something that can be maximised through mathematical calculations, and if irregularities or indications of invalid prayer times are found, it is fardhu kifayah to find a solution and improve the existing prayer time schedule.

The results of the analysis show that the westernmost point in the prayer schedule developing in Jambi province is not covered by considerations based on astronomical-mathematical calculations and can be explained scientifically. In fiqh, this can already be called convincing evidence, or in fiqh language it is called qarinah[18]. With the existence of a qarinah indicating that the westernmost area in the regency/city is not covered by the basis for calculating the prayer schedule, it is important to make corrections and find solutions so that the existing prayer schedule can meet the standard of wilayatul hukmi with the coverage of the regency/city area. The implementation of qarinah as the basis for changing the markaz criteria in calculating prayer times in Jambi province is in line with Qardhawi's statement when explaining the meaning of tajdid, which is to try to return it to its original state so that it appears as if it is something new. It is done in a way that strengthens what is weak, repairs what is worn out, and patches cracked activities so that they return to their former form, so that tajdidu din does not mean changing religion, but returning it as desired by Nash[19].

There is also another rule concerning the enactment of Islamic law, which has been in existence for as long as there has been no other thing (qarinah) to indicate that

[17] Musthafa Muhammad Az-Zuhaily, *Al-Qawaid al-Fiqhiyah wa Tathbiquha fi al-Madzahib al-Arba'ah*, (Dimasyqi: Dar al-Fikr, 2006), p. 658.

[18] Qarinah is a sign that reaches the limit of confidence which in terms can be explained as a sign or thing that has a close relationship with an event so that it can provide a clue, and with that guide a certain limit will be reached to be able to decide an event or event. Sayyid Sabiq, *Fiqh Sunnah*, trans. (Bandung: Al-Ma'rif. 1988), p. 82.

[19] Al-Qardawi, Yusuf, *Fi Fiqh al-Awwalawiyyat*, terj. "Fiqh Prioritas, penerjemah Muhamad Nur hakim. (Jakarta: Gema Insani Press, 1996), p. 107.

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the law needs to be changed or corrected, especially with regard to scientific problems that continue to develop over time. The rule reads:

الأصل بقاء ما كان على ما كان مالم يكن ما يغيره [20]

"The original law remains in that state as long as nothing else changes it".

Based on the above arguments, it is important to make corrections in the application of coordinates for prayer time markers, especially in Jambi province. The various analyses that have been carried out are sufficient to serve as a basis for making improvements; maximum efforts must be made by the parties concerned for the sake of the validity of the schedule, because the schedule made will be used by the wider community and will become the basis for them to conduct prayer services in their respective places.

In order to overcome the problems arising from the use of the markaz of the regency/city central mosque as the basis for calculating prayer times in Jambi province, this research recommends returning to the use of the markaz of the regency/city centre coordinates. This was done because the existing data showed that the location of the markaz largely determines the coverage of the resulting prayer schedule. For example, Muaro Jambi regency, with an area of more than 5000 km^2, has a prayer schedule that astronomically covers the entire area because the regency's central mosque is not far from its western point, in contrast to West Tanjung Jabung regency, where the central mosque is at the end of the east, so it cannot cover the westernmost point of the area. The use of centre point coordinates is then an effective solution after considering the average coverage of each area.

The centre of coordinates in the mapping language, the centroid, is the coordinate centre of an area. When an urban area is taken as the centre, the area and distance aspects are basically taken into account. The geometric centre of a two-dimensional area is the arithmetic mean of all the points bounding the area.[21].

D. Conclusion

Based on the findings and data analysis conducted, it can be concluded that the application of the coordinates of the regency or city central mosque in determining the initial prayer times in Jambi Province is based on the location of the regency/city central mosque, which is considered representative and represents the coordinates of the region. The coordinates of

[20] Walid Bin Yusuf as-Saidan, *Talqih al afham al Ulya bi syarh al qawaid al fiqhiyyah*, (t.t,t.tp), p. 43.

[21] Paul Bourke, "Calculating the Area and Centroid of a Polygon", University of Western Australia. diakses pada 18 Agustus 2022, http://local.wasp.uwa.edu.au.

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the central mosque are then used in calculations using the ephemeris method to produce regency/city prayer schedules, which are presented on the website of the Indonesian Ministry of Religion's Islamic Community Guidance to be applied to each regency/city, including Jambi province.

Secondly, the perspective of Falak science on the application of regency or city mosque coordinates in determining prayer times in Jambi province through the analysis conducted shows that there are several regencies/cities where the applicable prayer time schedule cannot cover the whole area, especially the area at the westernmost point of the region. The size of the area that cannot be covered in each region also varies, ranging from 12.36 km to 34.12 km. Converted into time, the maximum prayer time not covered between the two points is 1 minute 52 seconds. The data related to the non-coverage of the westernmost point in the growing prayer time schedule in Jambi Province, which was generated through considerations based on astronomical-mathematical calculations in fiqh, can already be said to be convincing evidence, or in fiqh language it is called qarinah, and has implications for the need to make corrections in the use of regency/city centre mosque markings in calculating prayer times in Jambi Province.

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