Iraqi Journal of Physics, 2024
https://doi.org/10.30723/ijp.v22i4.1313

Vol. 22, No. 4, PP. 67-78
P-ISSN: 2070-4003
E-ISSN: 2664-5548

Assessment of Wind Energy in the Ali Al-Gharbi Region

Jafar Mohammed Khadir[1a]*, Basim Abdulsada Al-Knani[1b], and Ahmed F. Hassoon[1c]
[1] *Department of Atmospheric, College of Science, Mustansiriyah University, Baghdad, Iraq*
[a*]Corresponding author: jafar941@uomustansiriyah.edu.iq

Abstract

Assessment of wind resources is an important issue in the wind industry. This study aims to assess wind energy in southern Iraq, especially in the Ali Al-Gharbi region. It includes field data for the wind speed at two altitudes (30 and 50m) in 2017, using the Weibull Distribution, wind power density and wind energy density equations. The probability density distribution of mean wind speed and daily, monthly, and seasonal wind speeds were calculated. The monthly mean wind power density and wind energy density at heights (30 and 50m) were estimated. The suitable wind turbine in this study area was the Unison U50. The capacity factor was assessed. The results showed a northwesterly prevailing wind speed direction in the study area. Mean wind speed increases during day hours and decreases during night hours throughout the four seasons. The highest monthly mean wind speed is in May and June. The highest seasonal mean wind speed is in spring and summer, while the lowest is in winter and autumn. The highest monthly mean of wind power density and wind energy density were in June, while the lowest values were in February. The highest monthly values of wind power, wind energy, and capacity factor were (5851.11kW, 4212802.15kW.h, 78%) respectively, while the lowest monthly values were (1080.43kW, 777913.34kW.h, 14%), respectively.

Article Info.

Keywords:
Weibull Distribution, Wind Speed, Wind Power Density, Wind Energy Density, Capacity Factor.

Article history:
Received: Jun. 13, 2024
Revised: Jul. 18, 2024
Accepted: Jul. 25, 2024
Published:Dec. 01, 2024

1. Introduction

The world is heading toward renewable energy (green, alternative, or environmentally friendly energy) in energy use and consumption [1-3]. Carbon dioxide (CO_2) emissions are the main product associated with the old ways of energy production, such as fossil fuels [4]. It is believed that temperature rise is not due to increased solar radiation reaching the Earth's surface, but rather due to other reasons, including increased concentrations of greenhouse gases [5]. Green energy sources are clean, environmentally friendly, and renewable, and do not emit harmful gases, such as carbon dioxide, nitrogen dioxide, and methane, that pollute the environment, and since their source are natural, they are not exhausted [6]. Renewable energies have the potential to provide relatively clean energy [7]. Renewable energy generation and its technologies are many and different. They can be generated from wind, sun, ocean, biomass, hydropower, and geothermal energy resources [8]. Wind energy has recently been considered one of the fastest-growing energy sources due to its numerous applications and advantages. Most energy-generating stations require large amounts of water, and wind energy does not require water to generate [9, 10]. Although wind farms are becoming increasingly common, some variables must be considered for their successful construction. One such criterion is to conduct a wind resource evaluation to determine the availability of energy at a potential location [11]. The most important parameter that must be considered when designing and studying wind power conversion systems is wind speed [7]**.** Several factors affect the electrical power generated by a wind turbine, including the wind characteristics and turbulence intensity; as the turbulence intensity increases, this leads to a decrease in the energy produced. Wind energy production is best suited to areas with strong wind speeds and moderate turbulence intensity [12]. Resen [1] conducted an assessment on wind resources in the Ali Al-Gharbi site. The results showed that the Ali Al-Gharbi site is the most suitable region in southern Iraq for wind energy production. Rasham [13] analyzed wind speed data and potential annual wind energy in three locations in southern Iraq (Amara, Nasiriyah, and Basra) and concluded that the highest rates of wind energy and wind power densities are during summer and spring. Bashar et al. [14] analysed wind speed data in four locations in southern Iraq (Amara, Nasiriyah, Basra, and Al-Hay) and concluded that the highest rates of wind energy and wind power densities are during summer and spring. Kareem [15] used the SAM program to evaluate wind energy. He reached the best productivity in the prevailing wind direction for the study area. Jung and Schindler [16] studied the efficiency and effectiveness of using global onshore wind energy. The capacity factor was used to analyse wind data. It was concluded that 81% of the world's onshore wind turbines are located in suitable locations; however, effectiveness of global wind is very rare. Abdulmenam et al. [17] studied atmospheric stability and its impact on wind power density for an entire year. The results showed that the highest monthly wind speed, wind power density, and wind energy density were noticed in June and July.

2. Measurement Site and Characteristics

Ali Al-Gharbi city is located 110 km northeast of Amara province and 27 km from the Iraqi-Iranian borders, at longitude and latitude of 32.4617°N and 46.6878°E, respectively. It is situated at an altitude of 44 meters above sea level. Field data was recorded from Ali Al-Gharbi meteorological station installed in the meteorological tower to monitor wind speed and its direction, temperature, in addition to other secondary parameter (neglected in this study), such as relative humidity, pressure, radiation intensity, and rainfall, etc. at 10-minute intervals and different heights (10, 30, 50 m) that approved by the Ministry of Iraqi science and technology. The device installed on the meteorological tower were (Stylitis-100) loggers from the Greek company (Symmetron), and sensors from the American company (Renewable NRG Systems). Table 1 describes the sensor type, country of mmanufacture, sensor time interval accuracy and working sensor range.

Table 1: Specifications of the sensor installed in Ali Al-Gharbi meteorological tower.

Sensor Type	**Parameter**	**Country of Manufacture**	**Sensor Time Interval**	**Accuracy**	**Working Sensor Range**
NRG #40C	Horizontal Component of Wind Speed	United States of America	10 minutes	± 0.15 m s^{-1}	(0.33 m $s^{-1)}$ to (24 m $s^{-1)}$

Fig. 1 (a and b) shows the location of the study area on the map and the meteorological tower of 50m height. The sensors were installed on the tower at three altitudes (50, 30 and 10 m). Building a tower to monitor and evaluate weather parameters is one of the projects that was funded by the Ministry of Science and Technology for scientific research (Iraqi government) under the project of wind energy and the construction of wind farms mission, in Ali Al-Gharbi region, because it considered one of the most promising areas in terms of producing electrical energy using wind turbines.

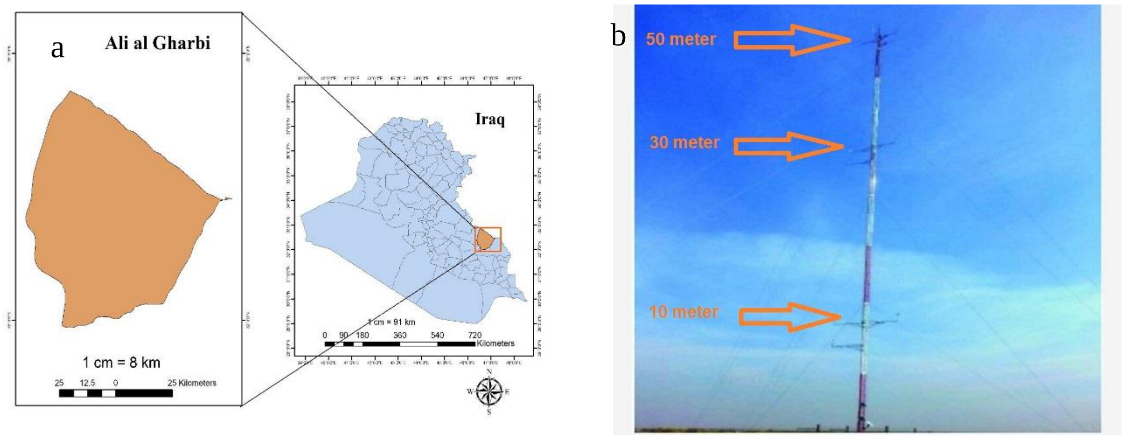

Figure 1: (a) Location of the study area on the map, and (b) the meteorological tower at height 50m, which displays the sensors installed at three heights (10, 30, and 50m).

3. Methodology

This research analyzed wind data (speed and direction) and evaluated wind energy in the Ali Al-Gharbi region based on field data from the meteorological stations installed in the study area employing a selected wind turbine placed at a height of 50m. The capacity factor was calculated to determine whether Ali Al-Gharbi location is suitable for establishing a wind farm. The data was processed, examined, and analyzed using (Microsoft Excel 2016), and the illustrations were produced using the (Origin 2024 program).

3.1. Weibull Distribution

The Weibull distribution, named after the Swedish physicist W. Weibull, is commonly used to model the probability distribution of several natural events. Weibull initially employed this distribution in his studies of material strength in tension and fatigue in the 1930s. The Weibull distribution has been a subject of interest for statisticians in both theoretical and methodological aspects, as well as in numerous branches of statistics, for over fifty years. Countless scholarly articles, possibly even in the thousands, have been dedicated to studying this particular distribution, and the research on it is still in progress. Undoubtedly, the Weibull distribution is the most widely used model in statistics. The theory-oriented statisticians find it highly intriguing due to its multitude of distinctive characteristics that allow it to accommodate data from diverse fields such as life sciences, meteorology, economics, healthcare, physics, social sciences, hydrology, biology, and engineering [18]. In this research, the maximum likelihood method was used to estimate Weibull parameters: the scale (c) and shape parameters (k).

The maximum likelihood method, with many required features, is the most widely used technique among other parameters estimation techniques. The Multilevel Modelling (MLM) possesses numerous desirable sample qualities, rendering it an appealing choice for utilization. As the sample size increases, the estimate values approach the true values, indicating asymptotic consistency [19]. The likelihood function of this random sample is the joint density of (n) random variables and is a function of the unknown parameter. The shape parameter (k) is

$$\mathrm{k} = \left(\frac{\sum_{i=1}^{n} v_i^{k} \ln(v_i)}{\sum_{i=1}^{n} v_i^{k}} - \frac{\sum_{i=1}^{n} \ln(v_i)}{n} \right)^{-1} \qquad (\mathbf{1})$$

when k is determined, the scale parameter (c) can be estimated using the equation

$$c = \left(\frac{\sum_{i=1}^{n} v_i^k}{n}\right)^{1/k} \tag{2}$$

where (v_i) is the wind speed in time step (i), and (n) is the number of nonzero wind speed data points [20].

3.2. Average Wind Speed (v_m)

One of the more important variables in the wind characteristics at any particular location is the wind speed. The average wind speed can be used to determine whether a wind site is suitable for large- or small-scale energy generation. The following formula [21] defines the average wind speed (m/s) of a specific place

$$v_m = \frac{1}{n}\sum_{i=1}^{n} v_i \tag{3}$$

where (v_m) is the average wind speed, (v_i) is the wind speed at (i) time, and (n) is the number of wind speed data.

3.3. Wind Power Density (WPD)

Power density refers to the power generated per unit area of the turbine's rotor-swept . WPD is determined in (W/m^2) and can be calculated by the following equation [22, 23]

$$WPD = \frac{1}{2}\rho v^3 \tag{4}$$

where: (ρ) represents the air density and (v) represents the horizontal wind speed. Wind power is not entirely efficient, with a theoretical maximum mechanical efficiency of only 59.3% for turbines [24]. Wind energy associations worldwide have worked to develop wind energy of various types and forms at the altitudes at which wind turbines operate to compare the available wind energy. This classification determines the maximum intensity of wind energy from wind at altitudes (30 and 50m) above the surface of the earth [25]. In the present research, the wind power density and wind classification at various altitudes (30 and 50m) were computed and identified.

3.4. Wind Energy Density (E)

Energy estimation at a chosen location is one of the most crucial phases in wind energy projects. The factor used to assess the site's energy potential is typically the amount of wind energy accessible within the regime across time [22]. Energy can be expressed as the following equation [26]

$$E = WPD \times T_i \tag{5}$$

where T_i represents the period, for instance wind energy density, T_i equals 720 hrs in a month [27].

3.5. Wind Turbine Selection

The turbine selected for this work was the Unison U50 with a rated capacity of 750kW. Table 2 shows the main specifications of the chosen turbine.

Table 2: Wind turbine technical specifications [28].

	Technical Specifications of (Unison U50)
Hub height	50 m
Rotor diameter	50 m
Swept area	1963 m^2
No. of blades	3
Rated power	750kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Rated wind speed	12.5 m/s
Rotational direction	Clockwise
Blade material	GRP
Rotor speed, max	28 U/min
Wind class (IEC)	IA
Rotor	Upwind rotor with active pitch control

3.6. Capacity Factor

Practically, the capacity factor (CF) is a dimensionless factor calculated by dividing the energy output by the maximum energy output of an individual turbine. This approach provides a more objective assessment of the energy output produced. Therefore, the energy output generated is referred to as the capacity factor. The CF is a quantitative measure that defines the ratio of the actual output of a power plant or system to its maximum possible output [29, 30]

$$\mathrm{CF} = \frac{\mathrm{E}}{\mathrm{E\ rated}} \times 100\% \qquad (\mathbf{6})$$

where E is the real power at a specific time, E rated represents the maximum power at a specific time of a particular turbine. The E rated of the turbines are specified by the manufacturer [31].

4. Results and Discussion

4.1. Probability Density Distribution

The frequency distribution of wind speed in different wind speed bins is a very important parameter in estimating energy production. In this study, the Weibull distribution function was used to evaluate the probability distribution of wind speed data at two altitudes (30 and 50 m). Fig. 2 shows Weibull probability density functions with histograms of wind speed data. The distribution is depicted with red line, the bars show the relative frequency with each bin of wind speed occurring in (1 $m.s^{-1}$), which appears along the x-axis and is based on the results obtained by wind speed analysis. The distributions show that the most frequent wind speeds are between (4 –6 m/s) at an altitude of 30m with annual mean wind speed (4.95 m/s), and (5-6 m/s) at 50m altitude, with annual mean wind speed (5.7 m/s). Shape parameter values at the two altitudes were (1.4-1.6), respectively. This indicates that the wind at the site is moderate. Scale parameter values at the two altitudes were (5.45 and 6.1 m/s), respectively; this indicates that the wind at the site increases with height.

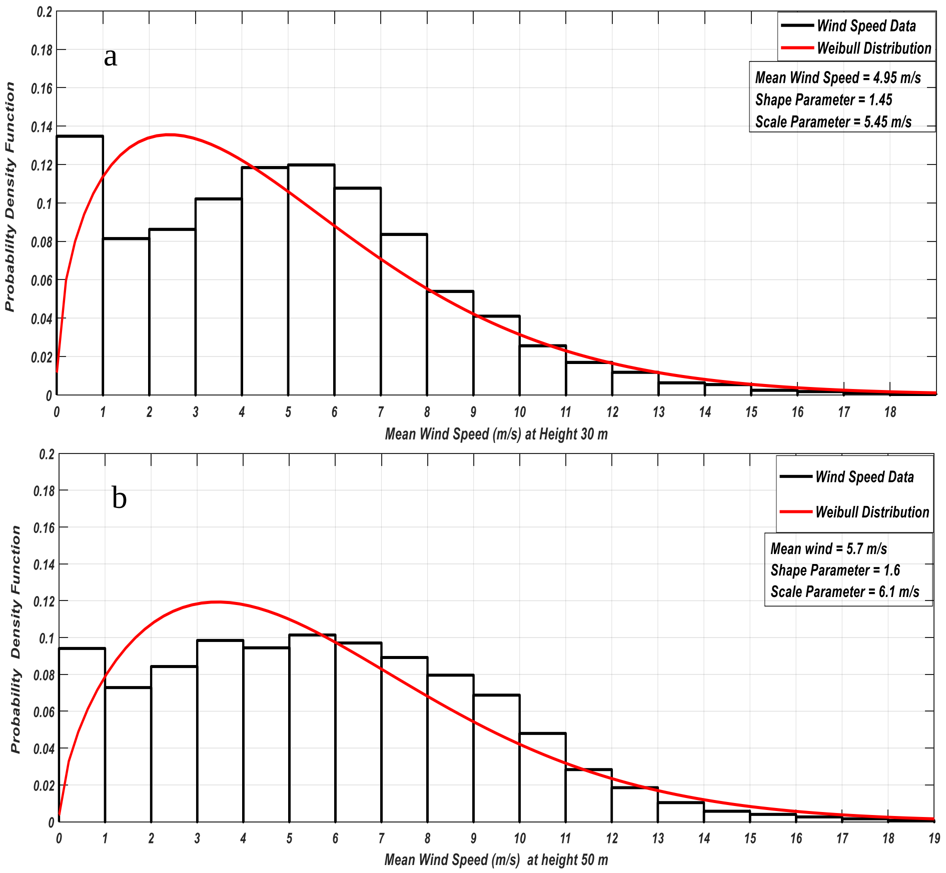

***Figure** 2**: Probability density distribution of mean wind speed using Weibull distribution with annual wind speed data histogram at two altitudes (a) 30 m, and (b) 50 m**.*

4.2. Wind Direction and Prevailing Winds

Fig.3 (a and b) shows the wind rise based on data obtained from the study area's meteorological tower at the two altitudes (30 and 50 m). Resen [1] found that the most common winds in the Ali Al-Gharbi region are northwesterly, with a percentage of prevailing wind direction of 44.5% at 50 m and 41.6% at 30 m. The prevailing wind direction remains the same (northwesterly) with changes in altitude.

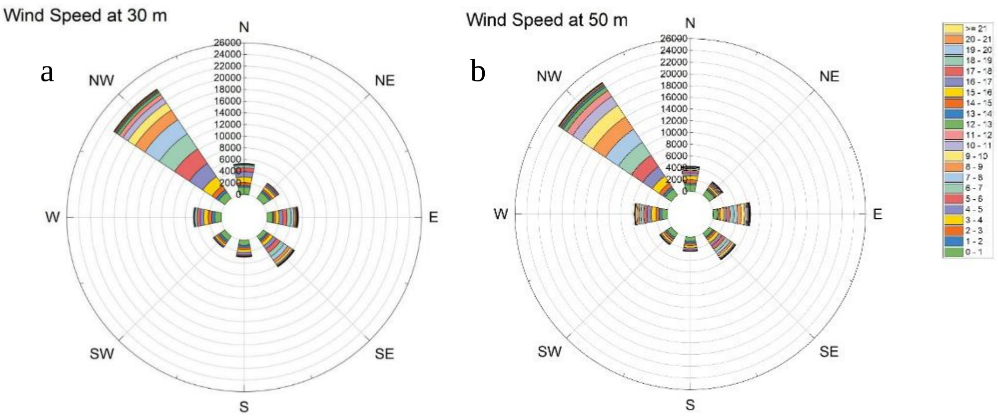

***Figure 3: A wind rose at two altitudes (a) 30 m, and (b) 50m**.*

4.3. Daily Behavior of Wind Speed

The daily behavior of wind speed at the study site at the two altitudes (30 and 50 m) during four seasons is shown in Fig. 4 (a , b, c and d). The wind speed increases with height, also the wind speed increases during sunrise and decreases during sunset**,** as was also concluded by Rasham [13]. During daytime hours, the change in wind speed with height is small due to the vertical movement of the wind, and the large amount of mixing between the layers of the boundary layer, and the conditions are unstable. While during night hours, the change in wind speed with height is large and noticeable due to the lack of mixing between the layers of the boundary layer, and conditions are stable. By observing this pattern, the wind speed at an altitude of 50 m was higher than the mean wind speed at an altitude of 30 m.

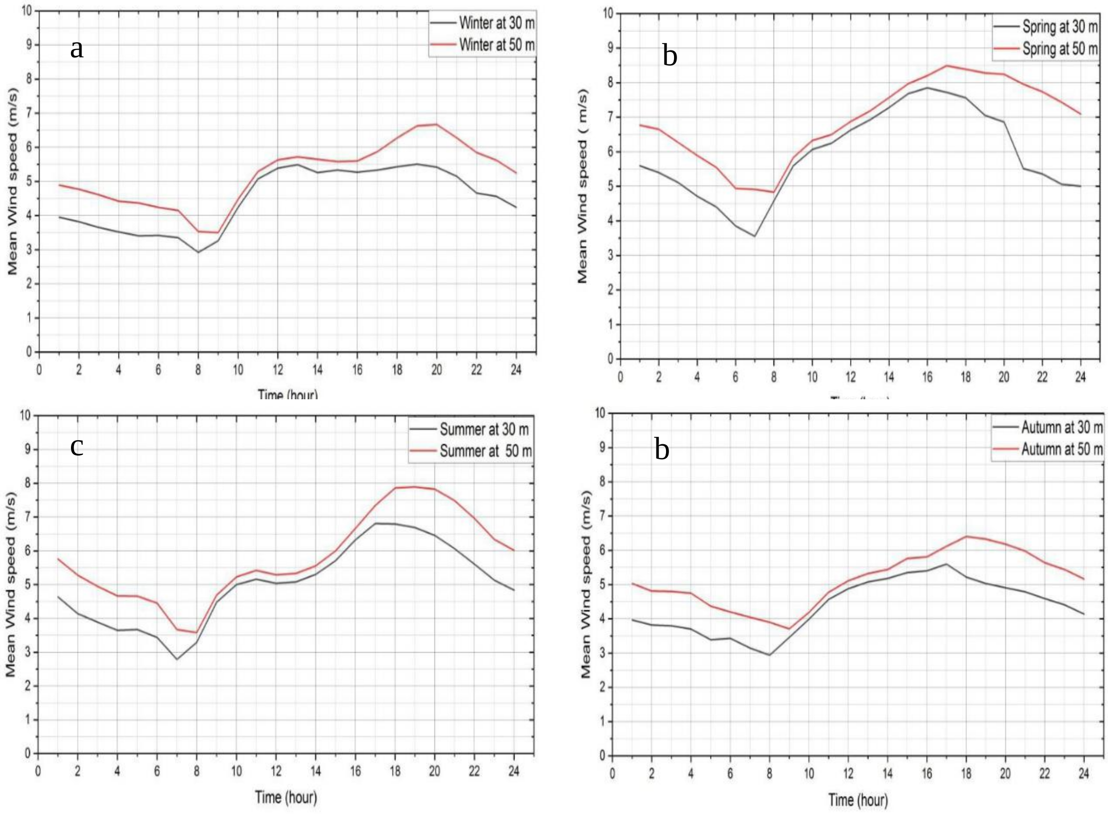

Figure 4: Daily behavior of wind speed (m/s) at two altitudes (30 m - 50 m) during four seasons (a) winter, (b) spring, (c) summer, and (d) autumn.

4.4. Monthly Behavior of Wind Speed

The monthly behavior of wind speed (m/s) at the study site at the two altitudes (30 and 50 m) during the entire year of (2017) is shown in Fig. 5. The highest monthly mean wind speed values were observed in May and June; the lowest values were in January and February, as was also concluded by Bashaer et al. [14].

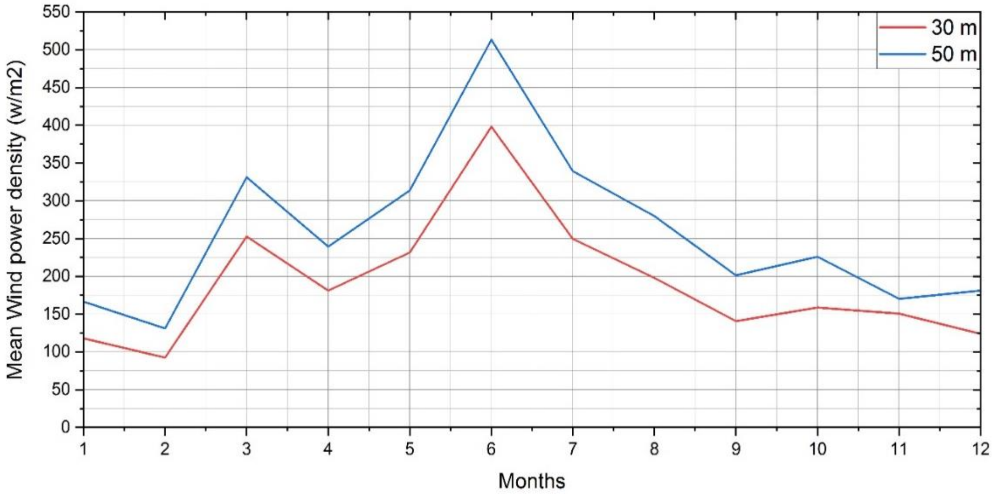

Figure 5: Monthly behavior of wind speed (m/s) at two altitudes (30 m - 50 m).

4.5. Seasonal Pattern of Wind Speed

The seasonal pattern of wind speed (m/s) at the two altitudes (30 and 50m) and for an entire year of 2017 is shown in Fig. 6. The highest mean of wind speed at the two altitudes (30m and 50m) were in spring and summer, while the lowest mean of wind speed at the two altitudes (30 and 50m) were in winter and autumn.

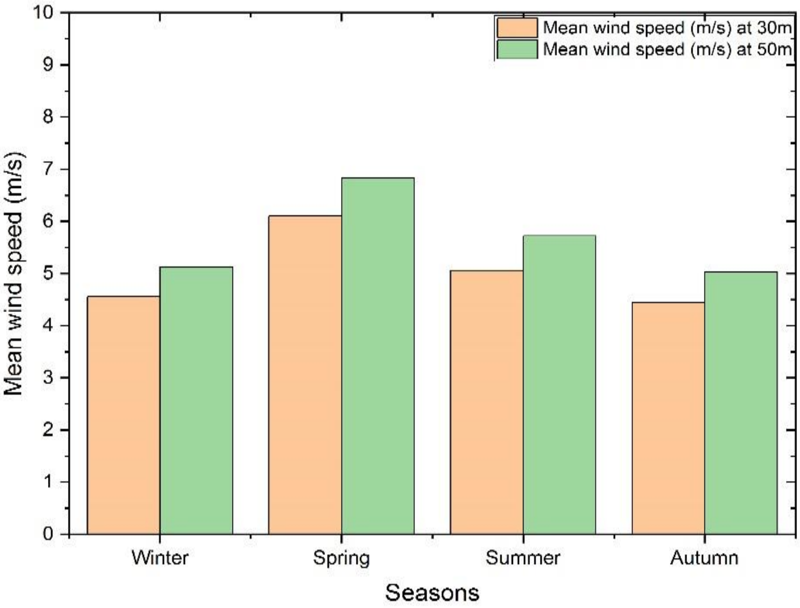

Figure 6: The seasonal pattern of wind speed (m/s) at two altitudes (30m - 50m).

4.6. Wind Power Density and Wind Energy Density

Fig. 7. shows the monthly mean wind power density at altitudes (30 and 50m) in 2017. The highest monthly wind power density values were noticed in June and July. This result agrees with that of Abdulmenam et al. [17]. While the lowest values were observed in January and February. Therefore, it can be concluded that the summer season has a higher wind power density than the other seasons.

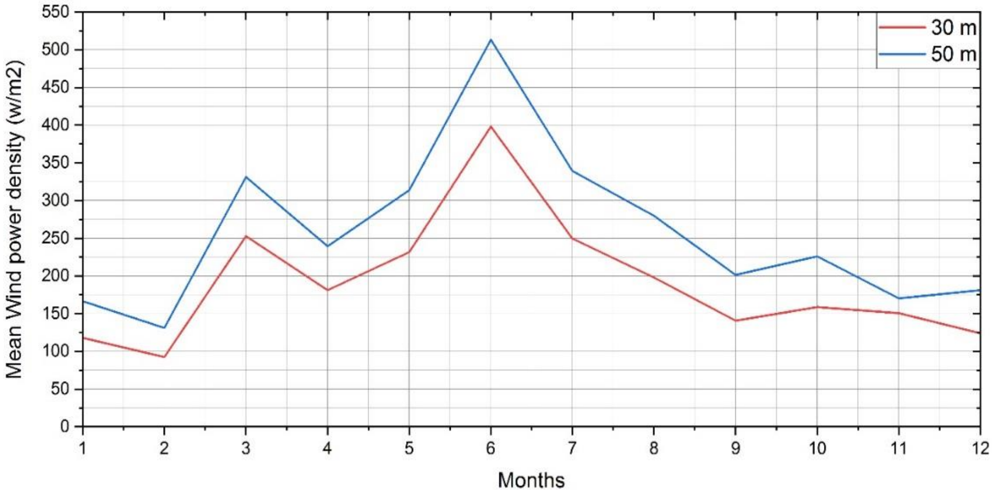

Figure 7: The monthly mean wind power density (w/m^2) at altitudes (30m - 50m).

Fig. 8 shows the monthly mean wind energy density at heights (30 and 50m) in 2017. The highest monthly wind energy density was noticed in June and July, which agrees with the results of Abdulmenam et al. [17]. These months have the highest wind energy potential in the study location. The lowest monthly value was observed in January and February. Therefore, it can be concluded that the summer season has a higher wind energy density than the other seasons.

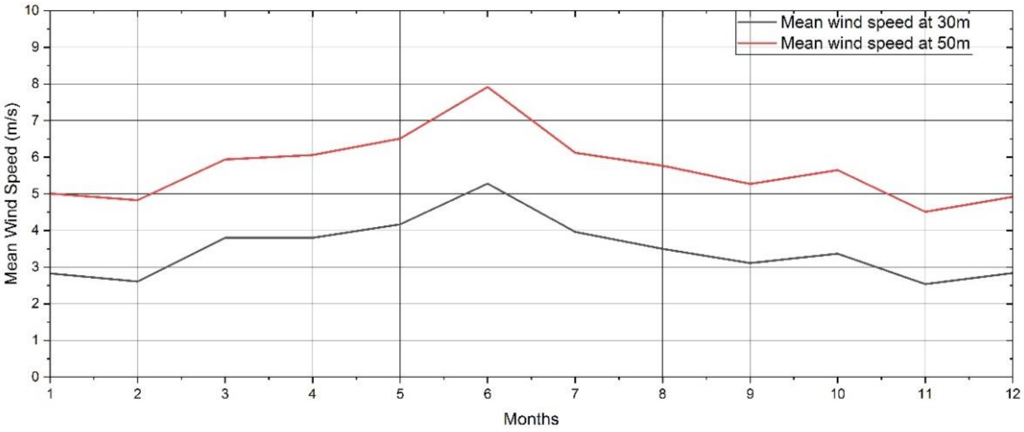

Figure 8: The monthly mean wind energy density (w.h/m^2) at altitudes (30m - 50m).

4.7. Wind Power Efficiency

Table 3 shows the monthly value of wind power, wind energy, wind energy rated for the turbine, and capacity factor for 2017 for the Ali Al-Gharbi site. The highest monthly values of wind power, wind energy, and capacity factor in June were (5851.11 kW, 4212802.15 kW.h, 78 %), respectively. The lowest values were in November (1080.43 kW, 777913.34 kW.h, 14 %), respectively**.**

Table 3: The monthly value of wind power, wind energy, wind energy rated for turbine, and capacity factor for 2017 for the Ali Al-Gharbi site.

Months	WPD*A (kW)	E (kW.h)	E rated (kW.h)	CF
Jan.	1481.08	1101926.12	5580000	19%
Feb.	1326.98	891735.93	5040000	17%
Mar.	2468.47	1836543.54	5580000	32%
Apr.	2620.99	1887118.27	5400000	34%
May.	3251.31	2418979.77	5580000	43%
June.	5851.11	4212802.15	5400000	78%
July.	2699.71	2008587.14	5580000	35%
Aug.	2262.55	1683340.02	5580000	30%
Sep.	1723.71	1241071.41	5400000	22%
Oct.	2124.16	1580376.75	5580000	28%
Nov.	1080.43	777913.34	5400000	14%
Dec.	1402.56	1043507.24	5580000	18%

5. Conclusions

By analyzing wind speed and direction data in the Ali Al-Gharbi region for an entire year, it was found that this region is suitable for producing wind energy by wind turbines. The findings indicated that the dominant wind speed direction at the research location is northwesterly. The distributions show that the most frequent wind speeds are between (4 –6 m/s) at 30m height with an annual mean wind speed of (4.95 m/s), and (5-6 m/s) at 50m height with annual mean wind speed of (5.7 m/s). Shape parameter (k) values at the two altitudes were (1.4, 1.6) respectively. This indicates that the wind at the site is moderate. Scale parameter values at the two altitudes were (5.45 – 6.1 m/s), respectively. This indicates that the wind at the site increases with height. There is an increase in mean wind speed during daylight hours and a reduction during night hours throughout the four seasons. The peak monthly average wind speed occurs in May and June. The peak seasonal average wind speed occurs throughout spring and summer; the lowest was observed in the winter and autumn. The wind turbine selected for the study area was the Unison U50, which was consider suitable for the purpose. In June, the wind power density and wind energy density reached their peak, whereas, in February, they reached their lowest monthly means. The highest monthly values of wind power, wind energy, and capacity factor were (5851.11kW, 4212802.15kW.h, 78%), respectively, while the lowest monthly values were (1080.43kW, 777913.34kW.h, 14%), respectively. The terrain's low degree of roughness contributed to stability in wind direction and setting up a wind farm is simple. This study was conducted to determine the potential of wind energy in the Ali Al-Gharbi region. The Ali Al-Gharbi region will make a significant contribution to the future electrical energy needs of Iraq through the wind industry. After verifying this study and through the results, it is recommended to study the impact of atmospheric stability when evaluating wind energy at any location, in addition to studying the impact of atmospheric stability on the structure and life of the wind turbine.

Acknowledgements

The authors would like to thank and appreciate the Iraqi Ministry of Science and Technology for providing the necessary data for this research.

Conflict of interest

Authors declare that they have no conflict of interest.

References

1. A. K. Resen, Iraqi J. Sci. **56**, 1216 (2015).
2. Q. Hassan, P. Viktor, T. J. Al-Musawi, B. Mahmood Ali, S. Algburi, H. M. Alzoubi, A. Khudhair Al-Jiboory, A. Zuhair Sameen, H. M. Salman, and M. Jaszczur, Renew. Ener. Focus **48**, 100545 (2024). DOI: 10.1016/j.ref.2024.100545.
3. S. Özdede, D. F. Kurtuluş, and B. Kurtuluş, RZGM2013-28, Conference On Wind Energy Science and Technology RUZGEM (Ankara, Turkey 2013). p. 3.
4. A. S. Hassan and J. H. Kadhum, Al-Mustansiriyah J. Sci. **32**, 47 (2021). DOI: 10.23851/mjs.v32i2.982.
5. B. A. Al-Knani, I. H. Abdulkareem, and Z. Nasir, Baghdad Sci. J. **18**, 1076 (2021). DOI: 10.21123/bsj.2021.18.2(Suppl.).1076.
6. P. Singh, S. Singh, G. Kumar, and P. Baweja, *Energy: Crises, Challenges and Solutions* (India, Wiley, 2021).
7. F. A. Hadi, B. Abdulsada Al-Knani, and R. A. Abdulwahab, Sci. Rev. Eng. Envir. Sci. **29**, 37 (2020). DOI: 10.22630/PNIKS.2020.29.1.4.
8. N. E. M. Stephanie, Ph.D Thesis, Centria University of Applied Sciences Environmental Chemistry and Technology, 2022.
9. K. Nwaigwe, Int. J. Envir. Sci. Tech. **19**, 4525 (2022). DOI: 10.1007/s13762-021-03402-2.
10. M. M. Abrar, Int. J. Sci. Eng. Res. **5**, 538 (2014).
11. Z. H. Hulio, W. Jiang, and S. Rehman, Ener. Strat. Rev. **26**, 100375 (2019). DOI: 10.1016/j.esr.2019.100375.
12. C. Pérez, M. Rivero, M. Escalante, V. Ramirez, and D. Guilbert, Energies **16**, 4134 (2023). DOI: 10.3390/en16104134.
13. A. M. Rasham, Int. J. Comp. Appl. **137**, 5 (2016). DOI: 10.5120/ijca2016908862.
14. M. Bashaer, O. I. Abdullah, and T. a. I. Al, FME Transact. **48**, 155 (2020). DOI: 10.5937/fmet2001155B.
15. K. K. Kraem, A. I. Altmimi, and T. O. Roomi, Mustansiriyah J. P. Appl. Sci. **2**, 104 (2024).
16. C. Jung and D. Schindler, Ener. Conver. Manag. **280**, 116788 (2023). DOI: 10.1016/j.enconman.2023.116788.
17. A. Abdalla, W. El-Osta, Y. F. Nassar, W. Husien, E. I. Dekam, and G. M. Miskeen, Appl. Sol. Ener. **59**, 343 (2023). DOI: 10.3103/s0003701x23600212
18. P. Lencastre, A. Yazidi, and P. G. Lind, Energies **17**, 2621 (2024). DOI: 10.3390/en17112621.
19. B. Fu, G. Fan, Y. Wang, M. Zhang, and S. Zheng, Res. Squar. **1**, 1 (2024). DOI: 10.21203/rs.3.rs-3821360/v1.
20. S. Jahan, N. Masseran, and W. Zin, Ener. Repor. **11**, 5456 (2024). DOI: 10.1016/j.egyr.2024.05.029.
21. Z. O. Olaofe and K. A. Folly, Int. J. Renew. Ener. Res. **2**, 250 (2012).
22. B. A. Al-Knani, Ph.D. Thesis, Mustansiriyah University, 2015.
23. A. E. Onay, E. Dokur, and M. Kurban, Elektr. Elektrotech. **27**, 41 (2021). DOI: 10.5755/j02.eie.28919.
24. A. Betz, *Introduction to the Theory of Flow Machines* (London, UK, Elsevier, 2014).
25. N. A. Mohamad, S. M. Zahari, and F. Fadzil, AIP Conf. Proc. **2895**, 090022 (2024). DOI: 10.1063/5.0195433.
26. R. Liu, L. Peng, G. Huang, X. Zhou, Q. Yang, and J. Cai, Ener. Conver. Manag. **292**, 117355 (2023). DOI: 10.1016/j.enconman.2023.117355.
27. H. Kumar Yadav, S. Yadav, M. Narayan Gupta, A. Sarkar, and J. Sarkar, Sustain. Ener. Tech. Assessm. **64**, 103744 (2024). DOI: 10.1016/j.seta.2024.103744.
28. L. Bauer and S. Matysik. *Unison U50 - 750,00 Kw - Wind Turbine*, wind-turbine-models.com; https://en.wind-turbine-models.com/turbines/1562-unison-u50#datasheet.
29. T.-J. Chang, C.-L. Chen, Y.-L. Tu, H.-T. Yeh, and Y.-T. Wu, Ener. Conv. Manag. **95**, 435 (2015). DOI: 10.1016/j.enconman.2015.02.033.
30. R. Bhandari, B. Kumar, and F. Mayer, J. Clean. Product. **277**, 123385 (2020). DOI: 10.1016/j.jclepro.2020.123385.
31. J. Park, K. Hwan Ryu, C.-H. Kim, W. Chul Cho, M. Kim, J. Hun Lee, H.-S. Cho, and J. H. Lee, Appl. Ener. **340**, 121016 (2023). DOI: 10.1016/j.apenergy.2023.121016.

تقييم طاقة الرياح في منطقة علي الغربي

جعفر محمد خضير[1] وباسم عبد السادة الكناني[1] واحمد فتاح حسون[1]
[1]قسم علوم الجو، كلية العلوم، الجامعة المستنصرية، بغداد، العراق

الخلاصة

يعد تقييم موارد الرياح قضية مهمة في مجال صناعة الرياح. تهدف هذه الدراسة الى تقييم طاقة الرياح في جنوب العراق وخاصة في منطقة علي الغربي والي تتضمن بيانات ميداية لسرعة الرياح على ارتفاعين (30م – 50م) لعام 2017 باستخدام معادلات نوزيع ويبل وكثافة قدرة الرياح وكثافة طاقة الرياح. تم حساب دالة الاحتمالية لمعدل سرعة الرياح. ايضا تم حساب متوسط سرعات الرياح اليومية والشهرية والموسمية. تم تقدير المتوسط الشهري لكثافة قدرة الرياح وكثافة طاقة الرياح على ارتفاعين (30م – 50م). توربينات الرياح المناسبة في منطقة الدراسة هي Unison U50. تم تقييم عامل القدرة. اظهرت النتائج ان الاتجاه السائد لسرعة الرياح في منطقة الدراسة هوة شمالي غربي. يزداد متوسط سرعة الرياح خلال ساعات النهار ويتناقص خلال ساعات الليل خلال الفصول الاربعة. اعلى متوسط شهري لسرعة الرياح هوة خلال شهري مايو ويوليو. اعلى متوسط لسرعة الرياح الموسية هوة خلال فصلي الربيع والصيف، في حين ان ادني متوسط لسرعة الرياح الموسمية في فصلي الخريف والشتاء. وكان اعلى متوسط شهري لكثافة قدرة الرياح وكثافة طاقة الرياح في شهر يونيو. في حين كان ادني متوسط شهري لكثافة قدرة الرياح وكثافة طاقة الرياح في شهر فبراير. وكانت اعلى القيم الشهرية لقدرة الرياح وطاقة الرياح وعامل القدرة (5851.11 كيلوواط – 4212802.15 كيلوواط. ساعة – 78%) على التوالي، في حين أدنى القيم الشهرية لقدرة الرياح وطاقة الرياح وعامل القدرة (1080.43 كيلوواط – 777913.34 كيلوواط. ساعة – 14%) على التوالي.

الكلمات المفتاحية: توزيع ويبل، سرعة الرياح، كثافة قدرة الرياح، كثافة طاقة الرياح، عامل القدرة.