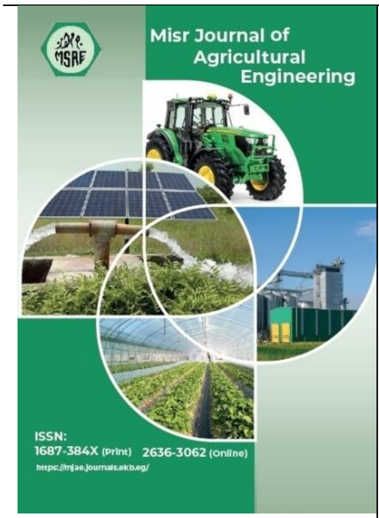
MISR JOURNAL OF AGRICULTURAL ENGINEERING ISSN-Print: 1687-384X
https://mjae.journals.ekb.eg/ ISSN-Online: 2636-3062
Misr J. Ag. Eng., 41 (4): 375 – 388 **DOI:** 10.21608/mjae.2024.305570.1141

EVALUATING THE EFFECTIVENESS OF LED LIGHT SPECTRA USING SOLAR ENERGY IN FISHERIES TO IMPROVE ATTRACTION AND SUSTAINABILITY

Hassan A. S.[1], El-Soaly I. S.[2], Shetawy M.A.[3] and Enas L. A. Salem[4]*

[1] MSc Stud., Ag. Const. Eng. and Env. Control, Fac. of Ag. Eng., Al-Azhar U., Cairo, Egypt.
[2] Prof., Former Dean, Ag. Const. Eng. and Env. Control, Fac. of Ag. Eng., Al-Azhar U., Cairo, Egypt.
[3] Prof., Vice Dean for Education Affairs, Ag. Const. Eng. and Env. Control, Fac. of Ag. Eng., Al-Azhar U., Cairo, Egypt.
[4] Res., Agric. Eng. Res. Institute (AEnRI), Agric. Res. Center (ARC).

*Email: dr.EnasSalem@outlook.com



Keywords:
Sustainable fishing; Night fishing; LED lighting efficiency in fishing; Portable solar energy units.

ABSTRACT

Small fishermen face daily challenges due to limited fish catches; resulting from the use of dilapidated traditional fishing tools that require continuous fuel and periodic maintenance, which increases the financial burden on the fisherman. This research aims to evaluate the effectiveness of LED light spectrums in fisheries to improve attraction and sustainability. This study focuses on the effect of different light spectra and light intensities on attracting fish, using white, blue, and green light, with intensities of 1000, 2000, and 3000 lumens at the non-full moon nights of 26th of January and 3rd of February 2023 AD (3rd Rajab and 11th Rajab 1444 AH). The study took place on the boat dock of Al-Gharam Beach, Marsa Matruh, Egypt. The results revealed a large variation in the effectiveness of different optical spectra and varying intensities. It is recommended to use 3000 lumens of white light during the non-moon nights, because it is the most effective at attracting fish. While blue was less effective and green light had a neglectable effect on attracting fish. These results contribute to the development of more efficient and environmentally friendly fishing techniques, which help improve the conditions of fishermen.

INTRODUCTION

Fishing plays a vital role in food security, livelihood, national gross domestic product GDP, poverty alleviation, and employment opportunities in rural areas. Egypt produces 1.9 million tons, and about 15.78% of it is produced from natural resources (marine and inland resources). In the last decades, production through natural resources has declined (Mehanna, 2022). Many different fishing gears have been used to increase the production of fishing in Egypt, these gears are dabba or trammel nets, El-Bouss or veranda, Kalsa or trawl nets, and Lines or sinner (Mehanna et al., 2020). Night fishing is the most common method among fishermen in developing regions, as these fishermen rely on compressed kerosene torches as a source of light to attract fish to their nets while fishing at night (Mills et al., 2014; Nguyen and Winger, 2019). The usage of light in night fishing operations has developed, as fluorescent and metal halide lamps have been widely used (Oluniyi Solomon and Olawale Ahmed, 2016). At the same time, LED technology has shown strong performance in terms of light power combined with energy efficiency, longer life, and lower cost (Nguyen et al., 2017, 2021). It is also possible, through the light produced by the LED, to use specific spectra to attract some types of fish and neutralize others (Marchesan et al., 2005; Wang et al., 2013; Susanto et al., 2022), which can lead to a decrease in the catch by 64.3% (Kakai, 2019).

This study aims to achieve two main objectives: firstly, the construction of a portable solar energy unit tailored for small-scale fishers to utilize during fishing activities; and secondly, the identification of optimal light spectrum and intensity to maximize catch yields. By focusing on the development of a practical solar energy solution and determining the most effective lighting parameters, this research endeavors to enhance the efficiency and productivity of fishing practices for small fishers, contributing to sustainable and resource-efficient fishing methods.

MATERIALS AND METHODS

2.1.Study region

The study was conducted in the offshore water at the boat dock of Al-Gharam Beach, Marsa Matruh Governorate on the north coast of Egypt (latitude 31°21'53.8"N, longitude 27°13'08.7"E). The dock (Fig. 1) is 4 m in depth, and 218 m in width, connecting Al Gharam Bay and the Mediterranean Sea, it is used to be the fishing location for the small fishers. The experiments have been done by 26th of January and 3rd of February 2023 AD (3rd Rajab and 11th Rajab 1444 AH) with no moon light that could interfere with our experiment. This location is characterized by absence considered tidal waves, and clear water that could affect the penetration of light till the depth of the dock.

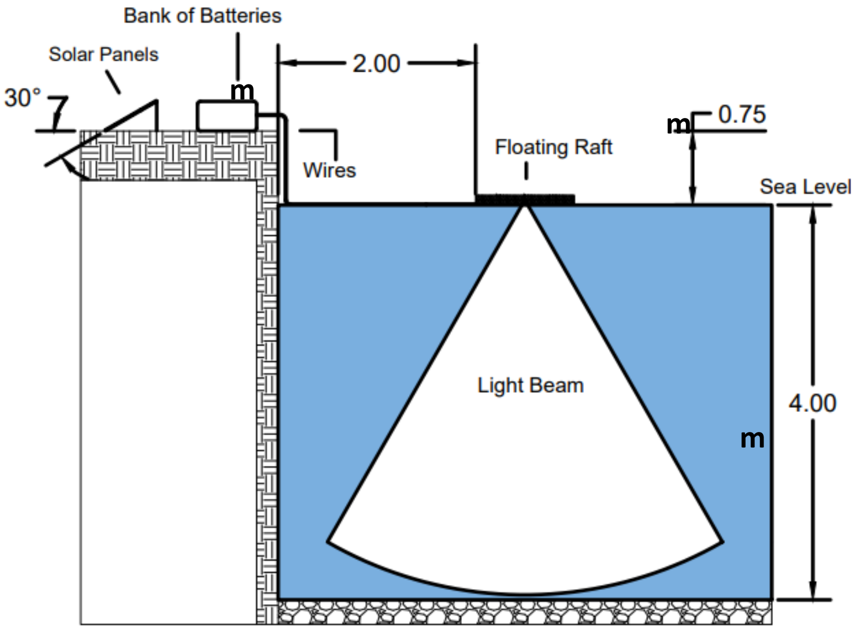


Fig. (1): A diagram for the experiment setup on the boat dock

2.2.Materials

A portable solar energy station (500 W) with dimensions 460 × 510 × 25 mm for the re-charging unit and 360 × 520 × 250 mm for the energy storage unit (Table 1). The re-charging unit consisted of two photovoltaic panels (30 W each), connected through well isolated galvanized wire (2 mm). While the storage unit consisted of two lead-acid sealed batteries (26 Ah each), a recharge controller (10 A), and an inverter (500 W). Fig. (2) shows a diagram of a battery charging system using solar energy to power LED floodlights. The batteries were designed to be fully charged within an average of 7 hours.

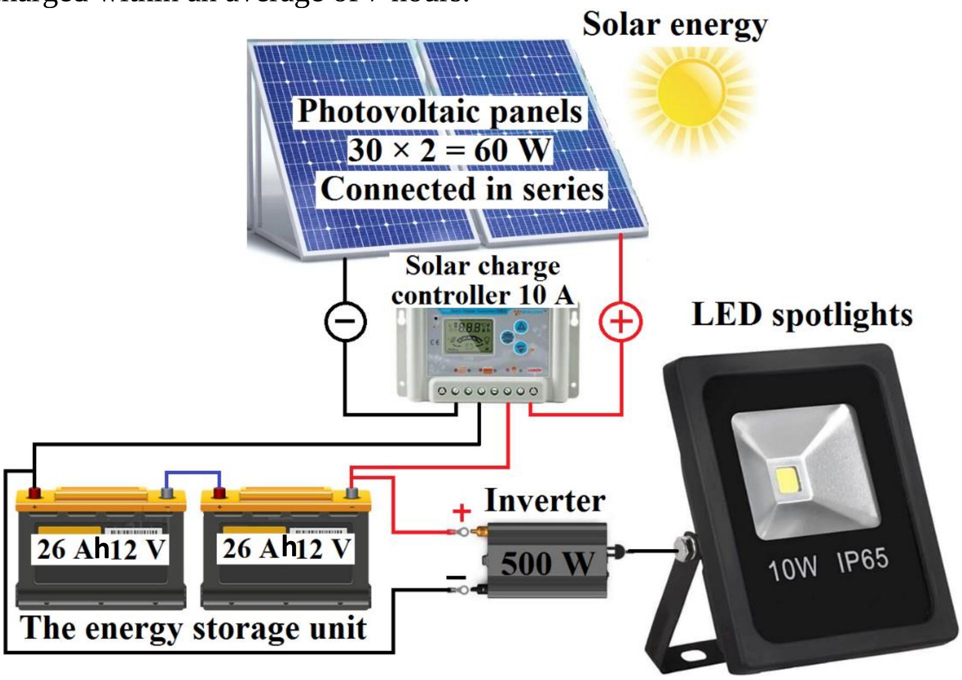


Fig. (2): A diagram of a battery charging system using solar energy to power LED floodlights.

Table 1: Technical and operational specifications for the used photovoltaic energy panels.

Parameters	Data
Dimensions (mm)	460 x 510 x 25
Power (W)	30
Maximum Power Voltage (V)	18
Maximum Power Current (A)	1.67
Open Circuit Voltage (V)	21.96
Short Circuit Current (A)	1.74

The re-charging unit consisted of two polycrystalline p-type photovoltaic panels (China) (30 W × 2 panels = 60 W) (Table 1) connected in series. The frame of the two photovoltaic panels was attached through a 180-degree metallic joint fixed on their stainless frame. This unit could be closed like a briefcase to be easily transported and then opened and tilted 30° anywhere while recharging.

The energy storage unit was equipped with two rechargeable sealed lead-acid WA12260 batteries (Westinghouse, China) (26 Ah each) connected in series, connected to recharge controller (Souer, China) (10 A), and pure sine wave inverter that was designed to convert the stored energy from 12 VDC to 220 VAC (Hopson, China) (500 W). All these parts have been organized inside a cork box.

A floating raft (Fig. 3) was designed by measuring 520 × 360 × 20 mm from foam. This floating raft aimed to provide LED buoyancy over the water during the experiment. The floating raft was placed directly over the water surface, and it had a cut hole to facilitate the controlled immersion of the LED lights, while the floodlight LED has been fixed on the floating raft tightly.

Table 2: Technical specifications of the floating raft.

Parameter	Data
Material	Foam
Length × Width (mm)	520 × 360
Thickness (mm)	20

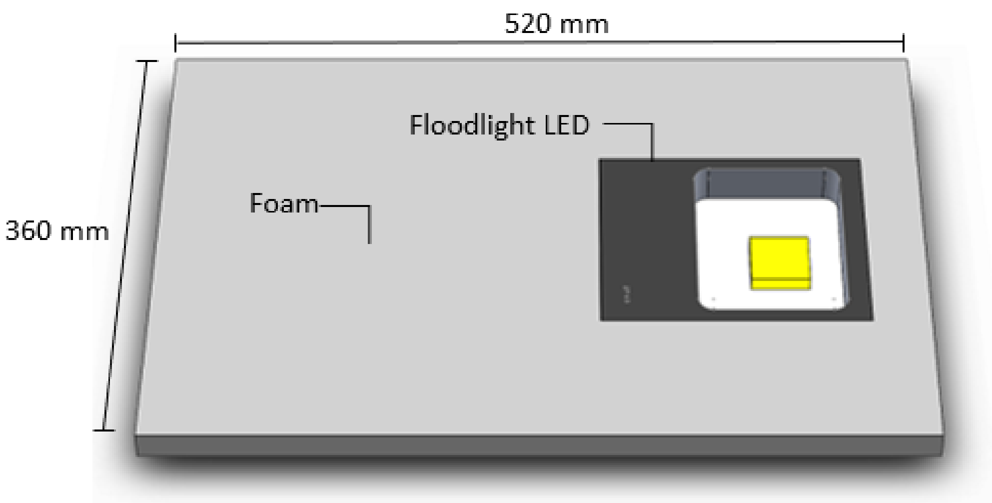


Fig. (3): A 3D Design for the Floating Raft

Three white-light rectangular LED floodlights (JW Light Systems, China) were used in the experiment, each exhibiting distinct luminous intensities of 1000 lumens, 2000 lumens, and 3000 lumens, respectively. To get different light spectrums, two filter sheets were used for the blue and the green color.

Table 3: Technical Specification of the flood lights used in the experiments.

Parameter	Data		
Manufacturer	JW Light Systems		
Origin	China		
Power (W)	10	20	30
Light intensity (lumens)	1000	2000	3000

2.3. Technical specifications of the measuring devices

2.3.1. Multimeter Specifications

A multimeter was used to measure both voltage and ampere during the charging and discharging phases for the charging unit. The multimeter that has been used has the following specifications:

Table 4: Multimeter manufacturer and technical data.

Parameter	Data
Manufacturer	China
Type	Digital
Voltage Range	750 VAC / 1000 VDC
Current Range	10 A (AC / DC)
Output Power Max	500 W

2.3.2.Professional Camera Specifications:

Two cameras were used in this experiment to take pictures of the attracted fish during the experiment. The two cameras were able to identify the school fish under different light spectrums. Videos and photos were taken during the experiment every 10 minutes to identify the effect of our variables on the fish. The two cameras were professional Nikon Coolpix S2600 camera and OPPO A5 2020 which has ultra night mode. They have been fixed on the marine dock, directed to the experiment area.

Table 5: Technical specifications for the cameras used in the experiment.

Parameter	Data	
	Nikon	Oppo
Type	Digital	Digital
Model	Coolpix S2600	A5 2020
Sensor Type	CCD	CMOS
Sensor Size (mm)	6.17 × 4.55	5.75 ×4.31
Effective Pixels (MP)	14	12
Max Resolution (Pixels)	4320 × 3240	4096 × 3072
Video Resolution (Pixels)	1280 × 720	1920 × 1080

2.4. Test Procedure

2.4.1. Energy Required

The energy needed has been calculated according to the following equations that have been described by Dunlop (2012) and Boxwell (2021):

$$E_i = P_i . h_i \qquad \ldots\ldots\ldots\ldots (1)$$

Where:

E_i is the daily energy consumption of the i-th device in watt-hours (Wh).

P_i is the power rating of the i-th device in watts (W).

h_i is the number of hours the i-th device is used per day.

Calculating the total energy consumption will be according to the following equation by Dunlop (2012):

$$E_{total} = \Sigma_{i=1}^{n} E_i \qquad \ldots\ldots\ldots\ldots (2)$$

The total working hours for the maximum loads are 5 hours, and the maximum loads are 30 W/h. After calculations, the needed energy was 150 W/day.

2.4.2. Power Loss

The efficiency factor is typically 0.8 to 0.85. Therefore, we have used the following equation described by Boxwell (2021) and Basaran and Feray Sezen (2018):

$$E_{required} = \frac{E_{total}}{\eta} \qquad \ldots\ldots\ldots\ldots (3)$$

Where:

η is the efficiency factor.

$$E_{required} = \frac{150}{0.8}$$

$$E_{required} = 187.5\ \mathrm{W}$$

2.4.3. Calculation of battery capacity

It has been considered one-day autonomy and the total energy needed according to the equation by Boxwell (2021):

$$E_{storage} = E_{required}.D \qquad \ldots\ldots\ldots\ldots (4)$$

Where:

D count of days of autonomy.

$$E_{storage} = 187.5 \times 1$$

$$E_{storage} = 187.5\ W$$

For lead-acid batteries, the recommended depth of discharge is typically around 50% to optimize lifespan and performance. Pena-Bello et al. (2017) mentioned that frequent deep discharges (below 50%) can lead to sulfation, which diminishes battery capacity and lifespan.

$$E_{adjusted} = \frac{E_{storage}}{0.5} \qquad \ldots\ldots\ldots\ldots (5)$$

$$E_{adjusted} = \frac{187.5}{0.5}$$

$$E_{adjusted} = 375\ W$$

As the system consumption was less than 500 W, it was recommended to select the voltage to be 12 V for small systems to provide the balance between efficiency, cost, and ease of installation (Olaszi and Ladanyi, 2017). Battery capacity was calculated according to the following equations described by Boxwell (2021) and Hankins (2010):

$$Battery\ Capacity\ (Ah) = \frac{E_{adjusted}}{System\ Voltage} \qquad \ldots\ldots\ldots\ldots (6)$$

$$Battery\ Capacity\ (Ah) = \frac{375}{12} = 31.25\ Ah$$

To calculate the number of batteries needed. The selected batteries were 26 Ah, so the number of the batteries is:

$$Number\ of\ Batteries = \frac{Battery\ Capacity}{Selected\ Battery\ Capacity} \qquad \ldots\ldots\ldots\ldots (7)$$

$$Number\ of\ Batteries = \frac{31.25}{26} \approx 2$$

2.4.4. Photovoltaic Power Calculation

The selected solar panels were 30 W, and the charging time was an average of 7 hours according to the geographical location. So, the power of the solar panels needed can be calculated by the equation described by Boxwell (2021):

$$Power_{PV} = \frac{E_{Batteries}}{Recharge\ Time} \quad \ldots\ldots\ldots\ldots (8)$$

Where:

$Power_{PV}$ is the power needed for the solar panels.

$$Power_{PV} = \frac{31.25 \times 12}{7} = \frac{375}{7} \approx 53.57\ W$$

The number of solar panels that should be used to recharge that amount of power should be:

$$N_{Panels} = \frac{Power_{PV}}{Selected\ Power} \quad \ldots\ldots\ldots\ldots (9)$$

Where:

N_{Panels} is the count of the panels.

$$N_{Panels} = \frac{53.57}{30} \approx 2$$

2.4.5. Solar charger calculation

The selection of the most proper solar charger of pulse width modulation type was done according to the following equation that has been described by Dunlop (2012):

$$I_{Charge} = \frac{P_{total}}{V_{system}} \quad \ldots\ldots\ldots\ldots (10)$$

$I_{Charge} =$ 60 W / 12 V = 5 A

Therefore, A PWM solar charger with a minimum amperage rating of 5 A was needed.

2.4.6. Inverter Power Calculation

The inverter power must exceed the needed power by 20-25% as a safety margin. It has been calculated based on the equation described by Boxwell (2021) and Hu et al. (2018):

$$Power\ of\ Inverter = Total\ Loads \times 1.25 \ldots\ldots\ldots\ldots (11)$$

The total power consumed at the same time was 30 W. It will be calculated as:

Power of Inverter = 30 W × 1.25 = 37.5 W

The power required was too small. Therefore, the solar charger controller with 10 A and the inverter with 500 W were selected.

2.4.7. Fish statical calculations:

To analyze the data and derive a general statistical formula, we need to consider the relationship between the variables: light intensity, color spectrum, and time, and the resulting number of fish observed. From the provided data, we can infer the following:

1. There is a positive correlation between light intensity and the number of fish observed.
2. Different color spectrums may have different effects on the number of fish observed.

3. Time also plays a role in the number of fish observed, but it may interact with other variables.

Based on these observations, a general statistical formula can be proposed:

$$Number\ of\ fish = f\ (Light\ intensity, Color\ spectrum, Time)\ \ldots\ldots\ldots\ (12)$$

To further specify the relationship, it can be considered using a regression analysis. Separate models for each color spectrum will be created and then expanded to include light intensity and time. A simple linear regression model that was described by Hastie et al. (2009):

$$Number\ of\ fish = \beta 0 + \beta 1 \times Light\ intensity + \beta 2 \times Time + \epsilon\ \ldots\ldots\ldots\ldots\ldots..\ (13)$$

Where:

- $\beta 0$ = Intercept.
- $\beta 1$ = Coefficient for Light Intensity.
- $\beta 2$ = Coefficient for Time.
- ϵ = error term, representing the deviation of observed values from the regression line.

This model will be fit to the data for each color spectrum separately. After fitting the models, the significance of each variable and their interactions can be assessed.

White Light Spectrum:

$$Number\ of\ fish = 0.02 + 0.003 \times Light\ intensity + 0.153 \times Time\ \ldots\ldots.\ (14)$$

Blue Light Spectrum:

$$Number\ of\ fish = 2.40 + 0.001 \times Light\ intensity + 0.049 \times Time\ \ldots..\ (15)$$

Green Light Spectrum:

$$Number\ of\ fish = 0.28 + 0.001 \times Light\ intensity + 0.017 \times Time\ \ldots..\ (16)$$

Calculating Mean:

It has been calculated according to the equation described by S.Moore et al. (2016)and G. Bluman (2017):

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n} \ldots\ldots\ (17)$$

Where:

- $\sum_{i=1}^{n} X_i$ is the total number of observed fish.
- n is a count of samples

RESULTS AND DISCUSSIONS

3.1. Color spectrum's effect

When using the three different light spectrums, which were white, blue, and green, the white light showed a significant effect on attracting fish than the blue light while the green color showed a neglectable effect (Fig. 4). White light has a faster response on attracting fish at 2000 lumens and 3000 lumens, while blue light was having faster response on 1000 lumens.

3.2. Light intensity effect

Utilization of different light intensities showed a high effect on fish attraction, especially with white light at 3000 lumens. On the other hand, green light did not show any notable effect on fish, from the results it is shown that it had no effect despite increasing the light intensity from 1000 lumens to 3000 lumens.

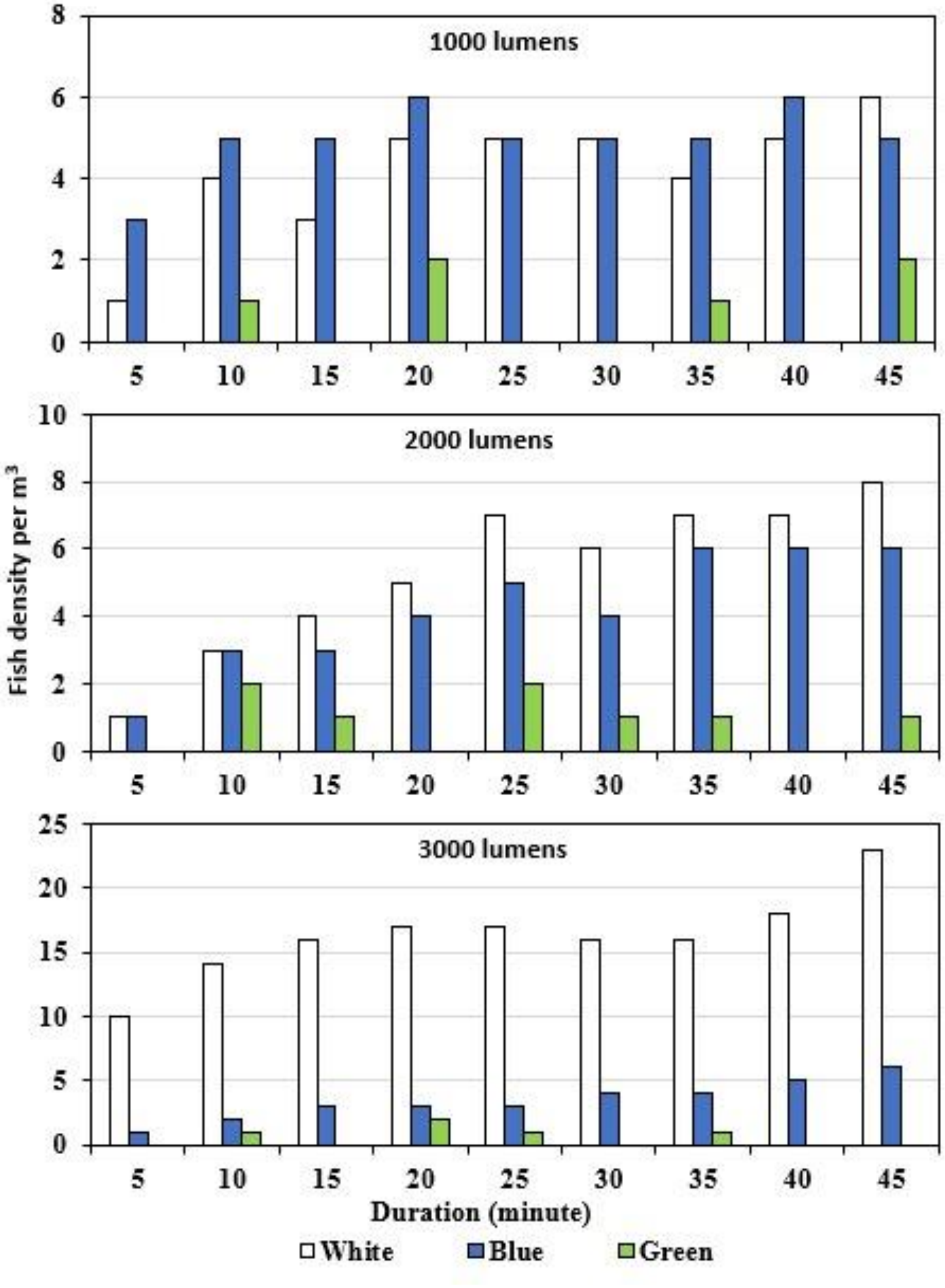


Fig. (4): Light effect on fish attraction at 1000 lumens, 2000 lumens, 3000 lumens with different light spectrums

To analyze the data and derive a general statistical formula, the data has to be organized into tables for better clarity:

Table 6: Fish density per cubic meter at light intensity 1000 lumens, 2000 lumens, 3000 lumens.

(1000 lumens light intensity)

Time (minutes)	Color spectrum		
	White Light	**Blue Light**	**Green Light**
5	1	3	0
10	4	5	1
15	3	5	0
20	5	6	2
25	5	5	0
30	5	5	0
35	4	5	1
40	5	6	0
45	6	5	2

(2000 lumens light intensity)

Time (minutes)	Color spectrum		
	White Light	**Blue Light**	**Green Light**
5	1	1	0
10	3	3	2
15	4	3	1
20	5	4	0
25	7	5	2
30	6	4	1
35	7	6	1
40	7	6	0
45	8	6	1

(3000 lumens light intensity)

Time (minutes)	Color spectrum		
	White Light	**Blue Light**	**Green Light**
5	10	1	0
10	14	2	1
15	16	3	0
20	17	3	2
25	17	3	1
30	16	4	0
35	16	4	1
40	18	5	0
45	23	6	0

Now, let us calculate the mean for each light spectrum at different intensities:

Mean for 1000 Lumens:

- White light= 4 Fish
- Blue light= 4.33 Fish
- Green light= 0.67 fish

Mean for 2000 Lumens:

- White light= *5.33 fish*
- Blue light= 4.33 fish
- Green light= 0.89 fish

Mean for 3000 Lumens:

- White light= 16.33 fish
- Blue light= 3.44 fish
- Green light= 0.56 fish

From these calculations, the mean number of fish increases with the increase in light intensity and varies with the light spectrum.

The investigation into the impact of different light spectrums on fish attraction revealed noteworthy observations. The three tested color spectrums white, blue, and green elicited varying responses in terms of their effectiveness in attracting fish. Unlike blue and green lights, the white light spectrum demonstrated a significantly higher efficacy in attracting fish at high light intensity (2000 and 3000 lumens). This preference for white light suggests that certain wavelengths within this spectrum may be more stimulating or attractive to the fish species under study. The reduced effect observed with green light suggests a potential lack of responsiveness to this color spectrum. These findings align with previous research that emphasizes the role of color spectrum in influencing fish behavior, with certain wavelengths being more conducive to attraction. The observed differences in fish attraction among the tested color spectrums emphasize the importance of selecting the appropriate lighting color when designing fish attractant systems. Further investigation could explore the specific spectral preferences of the target fish species, potentially revealing the underlying mechanisms that influence their responses to different spectrums of light.

CONCLUSION

The findings highlight the importance of future research into the unique behavioral signals and preferences that govern fish reactions to varied color spectrums and light intensities. This study adds to the evolution of fishing techniques and approaches for luring fish by emphasizing the significance of adjusting lighting conditions.

The investigation conducted focused on the impact of different light spectrums on fish attraction. Specifically, the experiments examined white, blue, and green light at three intensities of 1000, 2000, and 3000 lumens. The goal was to identify the most effective color spectrum and light intensity for attracting fish in fishing practices.

The results of our experiments at 3000 lumens showed a significant difference in the effectiveness of the different light spectrums in attracting fish. White light had a much stronger effect on fish attraction compared to blue and green light. This suggests that certain wavelengths within the white light spectrum are particularly appealing to the targeted fish species. On the other hand, both blue light and green light had lower effectiveness in terms of fish attraction at the tested intensity. Blue light had a more moderate response, while green light had negligible effects on fish attraction.

According to that, it is recommended that fishing practices, particularly night fishing, incorporate white LED lights at 3000 lumens intensity to enhance fish catch rates, leading to more efficient and productive operations. Additionally, while white light was generally the most effective, further research should explore the specific spectral preferences of different fish species, which could allow for more targeted and selective fishing practices, reducing bycatch. The development of portable, solar-powered LED lighting systems is also advised to support small-scale fishers by providing cost-effective and sustainable lighting solutions. Moreover, further studies should investigate the influence of environmental factors, such as water turbidity and moon phases, on the effectiveness of different light spectra and intensities. This deeper understanding will enable fishers to optimize their use of artificial light under various conditions, maximizing their catch while minimizing environmental impact. By adopting these recommendations, fisheries can improve operational efficiency, enhance sustainability, and support the livelihoods of small-scale fishers through more effective and eco-friendly practices.

REFERENCES

Basaran, K., and Feray Sezen, G. (2018). Economic analysis of an off-grid photovoltaic system. *International Congress on Energy Research*. https://www.researchgate.net/publication/328808241_Economic_analysis_of_an_off-grid_photovoltaic_system

Boxwell, M. (2021). *Solar Electricity Handbook 2021 Edition* (M. Boxwell, Ed.; 14th ed.). Greenstream Publishing.

Dunlop, James. P. (2012). *Photovoltaic Systems* (3rd ed.). AMERICAN TECHNIC AL PUBLISHERS.

G. Bluman, A. (2017). *Elementary Statistics: A Step By Step Approach* (10th ed.). McGraw-Hill Education.

Hankins, M. (2010). *Stand-Alone Solar Electric Systems: The Earthscan Expert Handbook for Planning, Design, and Installation"*. Routledge. https://www.perlego.com/book/1549585/standalone-solar-electric-systems-the-earthscan-expert-handbook-for-planning-design-and-installation-pdf

Hastie, T., Tibshirani, R., and Friedman, J. (2009). *The Elements of Statistical Learning*. Springer New York. https://doi.org/10.1007/978-0-387-84858-7

Hu, J., Harmsen, R., Crijns-Graus, W., Worrell, E., and van den Broek, M. (2018). Identifying barriers to large-scale integration of variable renewable electricity into the electricity market: A literature review of market design. *Renewable and Sustainable Energy Reviews*, *81*, 2181–2195. https://doi.org/10.1016/j.rser.2017.06.028

Kakai, T. M. (2019). Assessing the effectiveness of LED lights for the reduction of sea turtle bycatch in an artisanal gillnet fishery - a case study from the north coast of Kenya. *Western Indian Ocean Journal of Marine Science*, *18*(2), 37–44. https://doi.org/10.4314/wiojms.v18i2.4

Marchesan, M., Spoto, M., Verginella, L., and Ferrero, E. A. (2005). Behavioural effects of artificial light on fish species of commercial interest. *Fisheries Research*, *73*(1–2), 171–185. https://doi.org/10.1016/j.fishres.2004.12.009

Mehanna, S. F. (2022). Egyptian Marine Fisheries and Its Sustainability. In *Sustainable Fish Production and Processing* (pp. 111–140). Elsevier. https://doi.org/10.1016/B978-0-12-824296-4.00010-4

Mehanna, S. F., M.S. Eid, A. H., A. Ali, B., and S. Aabed, M. (2020). Fishing gears, catch composition and length at first capture of the common fish species in Bardawil lagoon, Egypt. *Egyptian Journal of Aquatic Biology and Fisheries*, *24*(5), 523–538. https://doi.org/10.21608/ejabf.2020.108593

Mills, E., Gengnagel, T., and Wollburg, P. (2014). Solar-LED alternatives to fuel-based Lighting for night fishing. *Energy for Sustainable Development*, *21*(1), 30–41. https://doi.org/10.1016/j.esd.2014.04.006

Nguyen, K. Q., and Winger, P. D. (2019). Artificial Light in Commercial Industrialized Fishing Applications: A Review. *Reviews in Fisheries Science and Aquaculture*, *27*(1), 106–126. https://doi.org/10.1080/23308249.2018.1496065

Nguyen, K. Q., Tran, P. D., Nguyen, L. T., To, P. V., and Morris, C. J. (2021). Use of light-emitting diode (LED) lamps in combination with metal halide (MH) lamps reduce fuel consumption in the Vietnamese purse seine fishery. *Aquaculture and Fisheries, 6*(4), 432–440. https://doi.org/10.1016/J.AAF.2020.07.011

Nguyen, K. Q., Winger, P. D., Morris, C., and Grant, S. M. (2017). Artificial lights improve the catchability of snow crab (Chionoecetes opilio) traps. *Aquaculture and Fisheries*, *2*(3), 124–133. https://doi.org/10.1016/J.AAF.2017.05.001

Olaszi, B. D., and Ladanyi, J. (2017). Comparison of different discharge strategies of grid-connected residential PV systems with energy storage in perspective of optimal battery energy storage system sizing. *Renewable and Sustainable Energy Reviews*, *75*, 710–718. https://doi.org/10.1016/j.rser.2016.11.046

Oluniyi Solomon, O., and Olawale Ahmed, O. (2016). Fishing with Light: Ecological Consequences for Coastal Habitats. *International Journal of Fisheries and Aquatic Studies*, *4*(2), 474–483.

Pena-Bello, A., Burer, M., Patel, M. K., and Parra, D. (2017). Optimizing PV and grid charging in combined applications to improve the profitability of residential batteries. *Journal of Energy Storage*, *13,* 58–72. https://doi.org/10.1016/j.est.2017.06.002

S.Moore, D., P. McCabe, G., and A. Craig, B. (2016). *Introduction to the Practice of Statistics* (9th Edition). W.H. Freeman.

Susanto, A., Suuronen, P., Gorgin, S., Irnawati, R., Riyanto, M., Wahyudin, Nurdin, H. S., Hamzah, A., Supadminingsih, F. N., and Syafrie, H. (2022). Behavioral response and retinal adaptation of Blue swimming crab (Portunus pelagicus) exposed to LED lights – Led light as a potential artificial attractant in trap fishing. *Fisheries Research*, *250,* 106274. https://doi.org/10.1016/j.fishres.2022.106274

Wang, J., Barkan, J., Fisler, S., Godinez-Reyes, C., and Swimmer, Y. (2013). Developing ultraviolet illumination of gillnets as a method to reduce sea turtle bycatch. *Biology Letters*, *9*(5), 20130383. https://doi.org/10.1098/rsbl.2013.0383

تقييم فاعلية أطياف ضوء LED باستخدام الطاقة الشمسية في مصايد الأسماك لتحسين الجذب والاستدامة

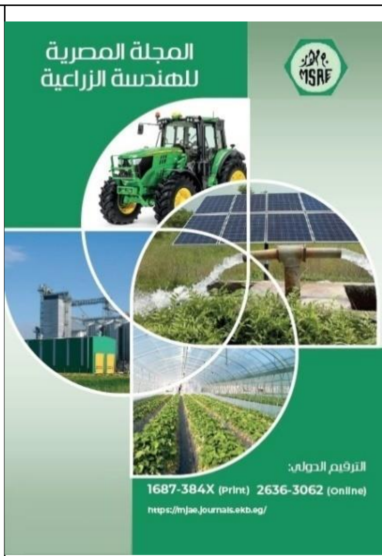
عبد الرحمن صفوت على حسن[١]، ابراهيم سيف احمد السؤالى[٢]، محمد احمد السيد شتيوى[٣]
و ايناس لقمان عبد اللطيف سالم[٤]

[١] طالب ماجستير بقسم هندسة المنشآت الزراعية والتحكم البيئي - كلية الهندسة الزراعية - جامعة الأزهر – القاهرة - مصر.

[٢] أستاذ دكتور وعميد سابق - هندسة المنشآت الزراعية والتحكم البيئي - كلية الهندسة الزراعية - جامعة الأزهر - القاهرة - مصر

[٣] أستاذ دكتور وكيل الكلية لشئون التعليم - قسم هندسة المنشآت الزراعية والتحكم البيئي - كلية الهندسة الزراعية - جامعة الأزهر - القاهرة - مصر.

[٤] باحث بمعهد بحوث الهندسة الزراعية - مركز البحوث الزراعية - وزارة الزرعة.



الكلمات المفتاحية:
الصيد المستدام؛ الصيد الليلي؛ كفاءة إضاءة LED في صيد الأسماك؛ وحدات الطاقة الشمسية المحمولة.

الملخص العربي

يواجه صغار الصيادين تحديات يومية بسبب كميات الصيد السمكية المحدودة؛ الناتجة عن استخدام أدوات صيد تقليدية متهالكة تتطلب وقودًا بشكل مستمر وصيانة دورية، مما يزيد من الأعباء المالية على الصياد. يسعى هذا البحث إلى استكشاف وتقييم طرق صيد بديلة باستخدام الطاقة الشمسية وأضواء الليد.

تركز هذه الدراسة على تأثير الأطياف الضوئية المختلفة وشدة الضوء على جذب الأسماك، باستخدام الضوء الأبيض والأزرق والأخضر، بكثافة ١٠٠٠ و٢٠٠٠ و٣٠٠٠ لومن في ليالي القمر غير المكتملة في ٢٦ يناير و٣ فبراير ٢٠٢٣م (٣ رجب و١١ رجب ١٤٤٤ هـ). أجريت الدراسة على رصيف القوارب في شاطئ الغرام، مرسى مطروح، مصر. كشفت النتائج عن تباين كبير في فعالية الأطياف الضوئية المختلفة ودرجات الشدة المتفاوتة. وبناءا على نتائج الدراسة، يوصى باستخدام الضوء الأبيض ذو شدة اضاءة ٣٠٠٠ لومن خلال الليالي غير القمرية، لأنه الأكثر فعالية في جذب الأسماك. في حين أن اللون الأزرق كان أقل فعالية وكان للضوء الأخضر تأثير مهمل على جذب الأسماك. تساهم هذه النتائج في تطوير تقنيات صيد أكثر كفاءة وصديقة للبيئة، مما يساعد على تحسين ظروف الصيادين.