

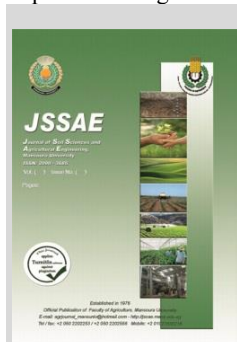
Journal of Soil Sciences and Agricultural Engineering

Journal homepage & Available online at: www.jssae.journals.ekb.eg

Comparison of Irrigation Methods and the use of Solar and Diesel Power for Modern Soil Irrigation

Hanan F. E. E. Mohammed* ; E. B. Elbanna and M. M. Abo Habaga

Department of Agricultural Engineering, Faculty of Agriculture, Mansoura University



Article Information
Received 28/ 8 /2025
Accepted 24/ 9/2025

ABSTRACT

This study was conducted on three farms in Egypt: Al-Banna Farm (Wadi El Natrun, Beheira), using a drip irrigation system; Hamed Farm (Sadat City, Menoufia), using a sprinkler irrigation system; and El-Gamil Farm (Ben Obeid, Dakahlia), using a flood irrigation system. The aim was to evaluate and compare solar- and diesel-powered irrigation methods in newly reclaimed lands. Soil samples were collected from five locations, and the mechanical properties of the soil and their impact on irrigation were analyzed. The results [P1] showed that drip irrigation, each Kw of power produced 57.24 kg of wheat yield, 69.85% and 70.99 % than the furrow and sprinkler systems, respectively. Each Kw of power produced 424.48 kg of onion yield by 71.66% and 72.2 % than the furrow and sprinkler system, respectively. Each Kw [P2] of power produced 45.43kg of bean yielded by 73.74% and 73.4 % than the furrow and sprinkler system, respectively. Each Kw of power produced 51.93kg of corn yield by 65.9% and 71.8% than the furrow and sprinkler system, respectively. The cumulative cost of the solar PV system is lower compared to the diesel system during the study period. The cost of solar energy / m³ of water extracted under the photovoltaic solar panel system is about 0.28 LE/m³, while the use of conventional diesel energy leads to a cost of about 2.2 LE/m³.

Keywords: Drip irrigation– The Solar Pv system - diesel energy- Sprinkler irrigation- Furrow irrigation

INTRODUCTION

Water is one of the most valuable natural resources that is subject to worldwide attention. Especially in dry areas and areas with limited water resources, improving water use efficiency in agriculture is very important. We must find solutions to the problems of water scarcity by developing irrigation methods. The type of irrigation system is important, and the availability of suitable irrigation systems meets the needs of agricultural expansion. Water irrigation has become the primary determinant of crop production. Surface and subsurface drip irrigation systems have been established to boost water productivity (Mailhol *et al.*, 2011).

Groundwater system in Egypt:

Due to the scarcity of water resources in arid and semi-arid regions such as Egypt, caused by climatic conditions of low rainfall, water loss through evaporation increases. According to (Abdel-Shafy and Kamel 2016), groundwater is one of the most important water resources in Egypt and ranks second after the Nile River. Water is one of the most essential intakes for financial development. With the growth in demand, the matter of water also advances. The future appears crucial if Egypt fails in managing its limited water resources amid increasing demand (Gad *et al.*, 2011).

Aquifers:

The expression "aquifer" reaches from the Latin terms "aqua" (water) and "ferre" (to carry). An aquifer is represented as a natural area (geological formation) below the surface that produces water in quantities large enough to be of economic interest (Davis, 1997).

Unconfined aquifers: Unrestricted aquifers, unlike limited aquifers, are generally discovered near the land shell and do not have layers of clay or other impervious geologic

materials above the water table, although they may lie above impenetrable clay or rock layers. The uppermost boundary of groundwater within an unconfined aquifer is the water table. Groundwater in unconfined aquifers is more vulnerable to contamination from surface pollution compared to confined aquifers, due to the easier infiltration of pollutants from the land surface (Elbanna *et al.*, 2018). Fluctuations in groundwater levels depend on the volume of water stored within the pore space of the aquifer, which in turn affects the rise or fall of water levels in wells sourcing from these aquifers. Unconfined aquifers typically have a storage coefficient (storativity) value greater than 0.01.

This type of aquifer is a completely saturated layer bounded above by a semi-permeable layer and below by an impervious layer. A semi-confined aquifer is defined as a layer that has low permeability (Dey *et al.*, 2017).

Semi-unconfined aquifers:

(Bell *et al.* 2013) showed that if a layer of permeable material is covered by an overlying layer of fine-grained, partly saturated material that is relatively impermeable compared to the aquifer itself, but with significant permeability that cannot be ignored, then such an aquifer is often referred to as semi-unconfined. These aquifers are between unrestrained and semi-confined essentials. The postponed yield of the overlying layer can result in a two-shape time-drawdown curve.

Subsurface studies of groundwater:

(Sikdar., 2019) reported that geophysical studies involve the measurement of basic physical parameters to infer subsurface conditions. Many geophysical techniques developed for oil exploration have also been adopted in groundwater exploration. The most common techniques are:

* Corresponding author.

E-mail address: enghanan357@gmail.com

DOI: 10.21608/jssae.2025.418579.1313

1. Electrical Resistivity: Applied to determine the depth of layer boundaries, the interface between fresh and saline water, and the availability of water in fractures.
2. Seismic Refraction: Used to determine the depth to the water table, the number and depth of layer boundaries, and bedrock.
3. Gravity: Used to determine the relative depth to bedrock and the thickness of alluvial deposits within an area.

Dynamic Water Level of Well:

Total active head (TDH) is the total "equivalent" vertical space that the pump must carry water, or the pressure the pump must overpower to move the water to a conveyed height. Water tension is represented in pounds per square inch (psi) and is described as the force caused by the weight of water in a column of a specific height, also known as the "head." Head is a phrase relating to the height of water in a column that yields a certain pressure. Understanding the head, you can select the pressure and vice versa. The head is

important for deciding how difficult the pump will operate to move the water from the source to the point of release (**i.e., to overcome the pressure equivalent to that water**).

The ongoing development of anthropogenic climate change and mitigation policies needs to account for the links between water consumption, energy use, and productivity levels, particularly in cases where energy-intensive responses may be promoted due to water scarcity (Maraseni *et al.*, 2012).

MATERIALS AND METHODS

Soil Mechanical:

Soil samples were taken randomly from the different cultivated soils in the three studied farms (Elbanna's, Hamid's, and El-Gamil's farms) at a depth of 0–40 cm. The collected soil samples were air-dried, then broken up and passed through a 2-mm sieve, as shown in Table (1) and (2)

Table 1. Soil physical properties of the experimental data

Farm name	Soil Type	Sand, (%)		Total Sand, (%)	Silt, (%)	Clay, (%)	CaCO ₃ , (%)	FC, (%)	OM, (%)	WP, (%)	bd, gm/cm ³
		Coarse	Fine								
Elbanna's	Sandy Loam	25.7	51.6	77.3	13.9	11.2	1.78	14.18	0.50	8.13	1.52
Hamid's	Sandy loam	22.8	45.7	68.5	18.4	11.8	1.45	16.2	0.47	8.7	1.42
ElGamil's	Clay	16.8	6.2	23	34.5	51.3	4.6	34.85	1.60	22.7	1.14

FC = field capacity OM = organic matter WP = wilting point bd = bulk density

Table 2. Soil soluble cations, and Ph and EC values

Farm name	Depth (cm)	Soluble cations (meq 100g-1 soil)				Soluble anions (meq 100g-1 soil)			Saturation S.P., (%)	PH	EC dS m ⁻¹
		Ca++	Na+	K+	Mg++	HCO ₃ -	Cl-	So ₄ -			
Elianna's	0-40	1.41	4.55	0.50	0.95	1.59	4.12	1.65	31.33	8.15	1.53
Hamid's	0-40	1.02	3.93	0.75	0.61	1.93	3.68	1.57	38.46	7.61	1.38
ElGamil's	0-40	0.72	3.62	0.08	0.36	0.76	2.98	1.04	72.1	8.03	0.97

SP = saturation percent

EC = Soil electrical conductivity

Irrigation Systems

1. Sprinkler irrigation system

The experimental work of this study was undertaken at Hamid's farm to evaluate the amount of water applied using a sprinkler irrigation system on several crops.

Components of the Sprinkler System:

The parts of the sprinkler irrigation system are generally similar and include a pump to supply the required pressure, main and branch pipelines, struts, and sprinkler heads. The cultivated area was irrigated with rotary-type

sprinklers featuring two nozzles with diameters of 4.5 mm and 3.6 mm (Nelson Rotator). The pump used in the system is 7 hp. The water pressure for each sprinkler is 3 bars. The sprinklers were arranged in a rectangular layout, with a spacing of 10 m between sprinklers and 12 m between sprinkler lines, each line being 12 m long. The diameter of the laterals was 75 mm. A constant hydraulic head of 50 m was delivered by the pump to feed the main pipe, which has a diameter of 125 mm and is installed at a depth of 1.5 m from the surface, as shown in figure (1).

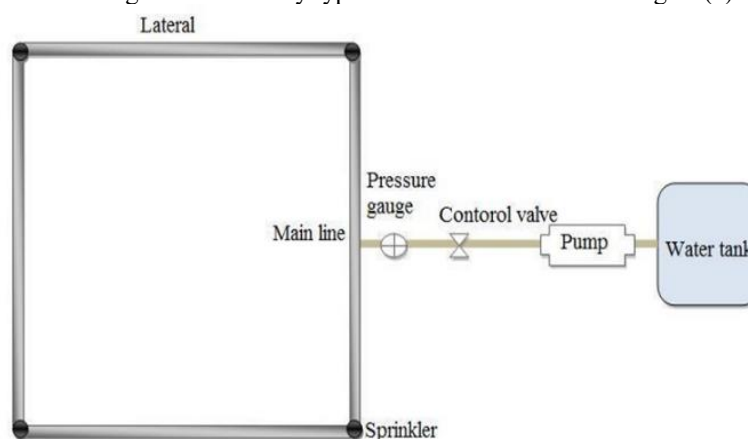


Figure 1. Layout of sprinkler irrigation system

2. Drip irrigation system:

The experimental work of this study was undertaken at El-banna's farm. To evaluate the amount of applied water

with a drip irrigation system of crops by using plastic bags to collect water under emitters for an hour, as shown in Figures (2) and (3).

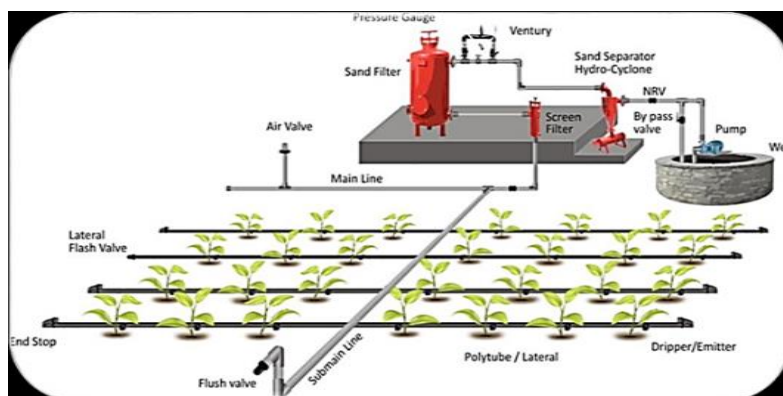


Figure 2. Drip irrigation system

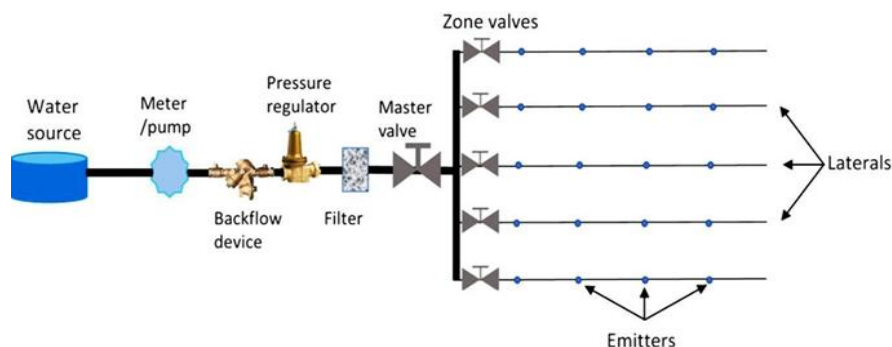


Figure 3. Layout of drip irrigation system

Amount of water applied:

Each treatment was replicated three time under furrow, sprinkler, and drip irrigation systems.

The amount of water was calculated according to Black *et al.*, (1965) as follows:

$$D = Fc - Wp100 BD \times bd \dots\dots\dots (1)$$

Where:

D = Depth of available water, (cm).

bd = Bulk density, gm/cm³

WP = Wilting Point, %

DR = Depth of root (cm).

$$\text{Total water requirements} = D \times A \times N \dots\dots\dots (2)$$

Where:

D = Depth of available water, (cm).

A = Area (one fad.)

N = Number or irrigated.

$$\text{Amount of irrigation water (Q)} = q \times t \dots\dots\dots (3)$$

Where:

Q = amount of irrigation water, m³/Fed

q = discharge, m³/min

t = total irrigation time, min/Fed.

Water Use Efficiency (WUE)

Water use efficiency values as kg grain/m³ of the applied water were calculated for different treatments after crop harvest according to Vites, (1965).

$$WUE = \text{Yield (kg/Fed) water applied (m}^3\text{/Fed) ... (4)}$$

Diesel system:

The diesel system uses fuel to operate the water pump. In this system, the total cost of the system includes the cost of the diesel unit, fuel, submersible and pump, oil and maintenance, and Figure (4) shows the diesel-powered water pumping system in Elbanna's farm in 2020. as shown in Tables (3) and (4).

Table 3. Specification of the system

Parameters	Value
Power	150 hp
Initial cost	113000 LE
The official price for a liter of diesel	6.75 LE
The average cost of litter of diesel, including transportation	7 LE
Change oil every 120 operating hours	700 LE
Engine maintenance / years	2500 LE
Diesel fuel consumption / day	160 litter
Maximum pumping height (m)	30
Pump flow rate	75 m ³ /h

Table 4. Specification of the pump

Parameters	Value
Initial cost of pump	15000 LE
The power of pump	30 Kw

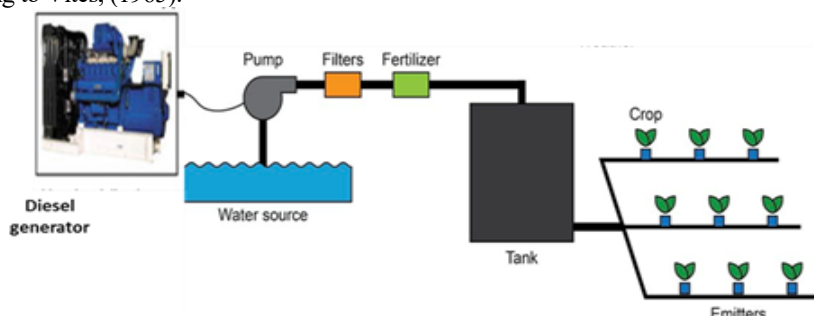


Figure 4. shows a Schematic of using diesel energy in drip irrigation

RESULTS AND DISCUSSION

The effect of different irrigation systems on the amount of water on one irrigated/Fed, m³/h

After conducting experiments on three farms using different irrigation systems: flooding, sprinkling, and dripping, on four crops (wheat, onions, beans, and corn), the data in the table below revealed that the amount of water used per acre varied depending on the irrigation system. The results showed that the drip irrigation system was the most water-efficient, recording the lowest amounts used compared to the other systems, followed by sprinkler irrigation, then flood irrigation, which recorded the highest water consumption. These results reflect the importance of choosing the appropriate irrigation system to achieve efficient use of water resources, especially in light of water scarcity and increasing environmental challenges. as shown in Table (5).

Table 5. Amount of water on one irrigated/Fed, m³/h

Crop	Irrigation system		
	Furrow	Sprinkler	Drip
Wheat	418.5	283.5	196
Onion	355.5	220.5	161.7
Bean	382.5	252	171.36
Corn	445.5	315	206.85

The table shows the total amount of water used during the growing season for each crop, taking into account the number of irrigations according to each irrigation system. The results show that drip irrigation consumes the least amount of water, regardless of irrigation frequency, followed by sprinkler irrigation. Flood irrigation, however, consumes the highest amount of water due to its low distribution efficiency. This data underscores the importance of choosing the appropriate irrigation system, based on the crop type, soil conditions, and climate, to achieve optimal water use throughout the season. as shown in Table (6).

Table 6. Amount of water for season (2020-2021) /Fed, m³/h

Crop	Irrigation system		
	Furrow	Sprinkler	Drip
Wheat	2511	2268	1960
Onion	1777.5	1543.5	1455.3
Bean	1912.5	1764	1542.24
Corn	2673	2520	2275.35

The data showed that the amount of water used to irrigate the four crops (wheat, onions, beans, and corn) differed significantly depending on the irrigation method used. Irrigation methods can be ranked in terms of water efficiency as follows:

Drip irrigation was the most water-efficient method, with crops using the least amount of water compared to other methods. The curves showed that water consumption was lowest across all crops when using this method, thanks to directing water directly to the plant roots and minimising losses through evaporation and surface runoff.

Sprinkler irrigation ranked second, with higher water usage compared to drip irrigation, but still lower than flood irrigation. The curves showed that sprinkler irrigation achieves a relative balance between efficiency and ease of application for some crops, such as wheat and corn, but it is less efficient than drip irrigation, especially in sandy soils.

Flood irrigation recorded the highest water consumption, and the curves showed a significant increase in water consumption for all crops when using this method,

especially in clay soils. This is due to the large amounts of water lost through evaporation and deep infiltration, making it the least efficient of the three methods.

In general, the curves show that switching from flood irrigation to drip irrigation leads to a significant reduction in water consumption, which has a positive impact on the efficiency of water resource use, especially in areas suffering from water scarcity. as shown in Figures (5) and (6).

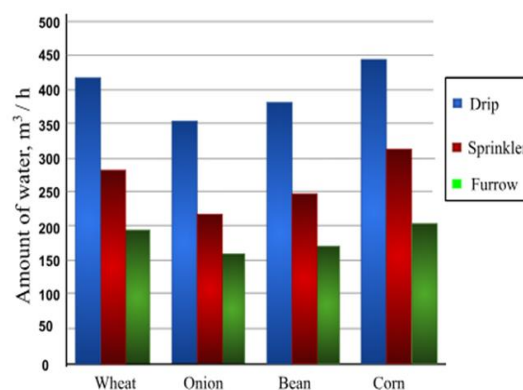


Figure 5. Showed the effect irrigation systems on the amount of water used for 4field crops

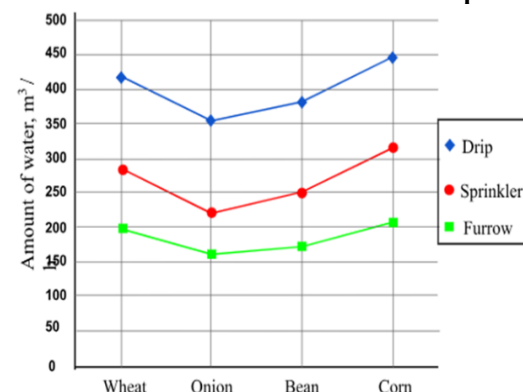


Figure 6. Amount of water for season (2020-2021) /Fed, m³/h effect of irrigation systems and amount of applied water on Crop yields and water use efficiency.

The values of water use efficiency investigated differences between all of the crops as shown in Tables (7) and (8). The highest values of water use efficiency were obtained under the drip irrigation system in all crops wheat, onion, bean, and corn throughout the season. It has been observed that the lowest value of WUE was recorded under furrow irrigation.

Table7. Crop yield obtained under different irrigation systems for the four crops

Irrigation system	Crop	Total volume of irrigation water for season, m ³ /Fed	Yield, kg/Fed	WUE, kg/m ³
Furrow	Wheat	2511	4150	1.65
	Onion	1777.5	22750	12.8
	Bean	1912.5	2900	1.5
	Corn	2673	3840	1.4
Sprinkler	Wheat	2268	3900	1.72
	Onion	1543.5	12030	13.15
	Bean	1764	2750	1.56
	Corn	2520	3800	1.51
Drip	Wheat	1960	3830	1.96
	Onion	1455.3	20670	14.21
	Bean	1542.24	2860	1.86
	Corn	2275.35	3620	1.6

Table 8. Crop yield and power requirement for season as affected by irrigation systems and amount of applied water.

Irrigation system	Crop	Operating time, hr	Total volume of irrigation water for season, m ³ /Fed	Yield, kg/Fed	Power requirement, Kw	Crop yield, kg/Kw
Furrow	Wheat	270	2511	4150	217.35	19.09
	Onion	225	1777.5	22750	154.35	147.39
	Bean	225	1912.5	2900	166.05	17.5
	Corn	270	2673	3840	198.186	19.4
Sprinkler	Wheat	72	2268	3900	176.04	22.15
	Onion	49	1543.5	20300	136.92	148.3
	Bean	56	1764	2750	156.48	17.6
	Corn	80	2520	3800	195.6	19.5
Drip	Wheat	5	1960	3830	72.5	52.83
	Onion	4.5	1455.3	20760	53.595	385.7
	Bean	4.5	1542.24	2860	56.79	50.4
	Corn	5.5	2275.35	3620	83.77	43.21

The average value of WUE under drip irrigation through the season increased by 14.41% and 10.4% than the furrow and sprinkler irrigation systems.

The results clearly show that drip irrigation systems outperformed other systems for all studied crops (wheat, onions, beans, and corn), in terms of:

- Water use efficiency (kg/m³)
- Energy use efficiency (kg/Kw)

Seasonal productivity (tons/acre) compared to unit resource use.

Next in the ranking was sprinkler irrigation, which recorded average efficiency performance.

Flood irrigation came in last, despite sometimes achieving higher absolute productivity. However, its high water consumption and low efficiency made it the least economically and environmentally feasible.

As shown in Table (9) For the yield of wheat under drip irrigation, each Kw. of power produced increased by

63.9% and 58.07% than the furrow and the sprinkler irrigation system. For the yield of onion under drip irrigation, each Kw. of power produced increased by 61.8% and 61.6% than the furrow and the sprinkler irrigation system.

For the yield of bean under drip irrigation, each Kw. of power produced increased by 65.3% and 65% than the furrow and the sprinkler irrigation system. As the yield of corn under drip irrigation, each Kw. of power produced increased by 55.1% and 54.1% than the furrow and the sprinkler irrigation system.

By following up on the progress of work during the period under study, the results were as follows:

In the first year:

- Cost of the solar system = EGP 185,000 (including initial cost + first year of operation)
 - Cost of the diesel system = EGP 501,505 (including initial cost + first year of operation)
- Diesel is initially more expensive by + EGP 316,505.

Table 9. Crop yield for season as affected by irrigation systems.

Crop	Crop yield, kg/Kw			The percentage of drip irrigation to furrow irrigation, %	The percentage of drip irrigation to sprinkler irrigation %
	Furrow	Sprinkler	Drip		
Wheat	19.09	22.15	52.83	63.9	58.07
Onion	147.39	148.3	385.7	61.8	61.6
Bean	17.5	17.6	50.4	65.3	65
Corn	19.4	19.5	43.21	55.1	54.1

2. From the second year onwards:

- The cost of the solar system gradually increases at a constant rate (approximately EGP 35,000/year), which is the labor cost only, as the remaining operating costs are zero.
- The cost of the diesel system increases rapidly each year, at a rate of EGP 388,505 (fuel + oils + maintenance + labor).

3. In Year 10:

- Solar System: 500,000 EGP.
 - Diesel System: 3,998,050 EGP.
- Difference = approximately 3.5 million EGP.

4. After Year 10:

- The diesel system is not included in the table (because it has reached the maximum number of years estimated in the previous calculations), while the solar system continues at a fixed and low cost.

5. In Year 25:

- **Solar System: Only 1,025,000 EGP**

This means that the cost of the solar system over 25 years is only a quarter of the cost of the diesel system over 10 years.

The solar system is much cheaper in the long run, and its annual cost is fixed and predictable. The diesel system is completely uneconomical if an operation period exceeding 5 years is considered. The solar system is not subject to the risks of fuel price fluctuations or high maintenance costs. The table clearly reflects the importance of investing in renewable energy, especially in rural and agricultural areas. as shown in Tables (10) and (11).

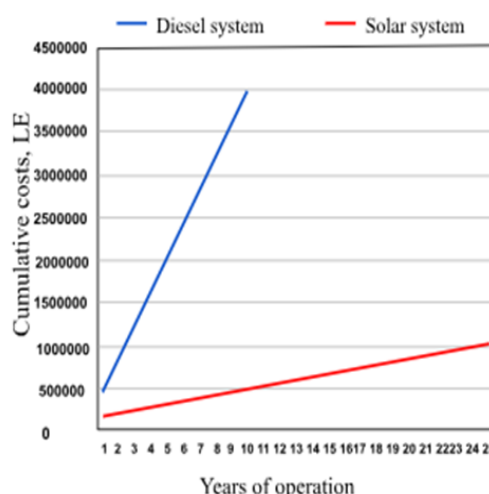
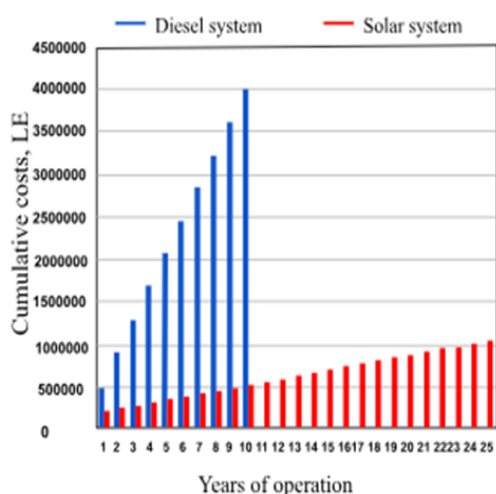
Finally, during the study period, we find that the solar power system has a higher initial cost than the diesel power system. However, a solar system has lower cumulative costs than a diesel system due to the ever-increasing fuel and oil costs, replacement and maintenance costs. Additionally, if the study considers fuel prices to be increasing, these numbers may continue to rise. So, the solar energy/m³ of extraction water was 0.35 LE/m³ while the diesel energy was 2.2 LE/m³. The cost of using solar energy is 15.91% that of diesel energy use. As a result, farmers must be encouraged to use solar energy to operate underground wells and irrigate modern lands. as shown in Figure (7).

Table 10. The cost of solar energy

The operation system years of operation	Cost of solar energy (LE)
1	150.000 (Initial cost) + 35.000 (Labors cost) = 185.000
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	35.000
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
Total	1.025.000

Table 11. Cumulative costs of diesel and solar system

years of operation	Cost of solar system (LE)	Cost of diesel system (LE)
1	185.000	501.505
2	220.000	890.010
3	255.000	1.278.515
4	290.000	1.667.020
5	325.000	2.055.525
6	360.000	2.444.030
7	395.000	2.832.535
8	430.000	3.221.040
9	465.000	3.609.545
10	500.000	3.998.050
11	535.000	
12	570.000	
13	605.000	
14	640.000	
15	675.000	
16	710.000	
17	745.000	
18	780.000	
19	815.000	
20	850.000	
21	885.000	
22	920.000	
23	955.000	
24	990.000	
25	1.025.000	

**Figure 7. Cumulative costs of diesel and solar systems**

CONCLUSION

The results can be summarized as follows:

- **Total amount of water** for season for (wheat crop) = 1960 m³/Fed for drip irrigation and 2268 m³/Fed for sprinkler irrigation and 2511 m³/Fed for furrow irrigation, and (onion crop) = 1455.3 m³/Fed for drip irrigation and 1543.5 m³/Fed for sprinkler irrigation and 1777.5 m³/Fed for furrow irrigation, and (bean crop) = 1542.24 m³/Fed for drip irrigation and 1764 m³/Fed for sprinkler irrigation and 1912.5 m³/Fed for furrow irrigation, and (corn crop) = 2275.35 m³/Fed for drip irrigation and 2520 m³/Fed for sprinkler irrigation and 2673 m³/Fed for furrow irrigation.
- **Water use efficiency** achieved the highest values under drip irrigation compared to sprinkler or furrow irrigation.
- **Energy Efficiency** in Irrigation Under drip irrigation, each kilowatt of energy produced 52,83 kg of wheat yield 63.9

and 58.07% of the furrow and sprinkler system respectively, each kilowatt of energy produced 385,7 Each kilowatt of energy produced 61.8 and 61.6% of the onion crop from the furrow and sprinkler system respectively, each kilowatt of energy produced 50.4 kg of the bean crop at the rate of 65 and 65.3% from the furrow and sprinkler system respectively, each produced Kilowatt of energy 43.21 kg of corn yield 54.1 and 55.1% of the furrow and sprinkler system respectively.

This study is presented to compare between two energy systems: diesel energy from traditional fossil fuels and solar energy from PV panels used in the water pumping system during the irrigation process, the study shows that the solar energy system has a higher initial cost than the diesel generator. However, the solar system has a lower cumulative cost than the diesel system during the study period. Therefore, it is recommended to use solar energy.

REFERENCES

- Abdel-Shafy, H. I., & Kamel, A. H. (2016). Groundwater in Egypt issue: resources, location, amount, contamination, protection, renewal, future overview. *Egyptian J. Chemistry*, 59(3), 321-362.
- Bell, R. A., Darling, W. G., Ward, R. S., Basava-Reddi, L., Halwa, L., Manamsa, K., & Dochartaigh, B. Ó. (2017). A baseline survey of dissolved methane in aquifers of Great Britain. *Science of the Total Environment*, 601, 1803-1813.
- Buddemeier, R. W. (1988). Hydrology and Radionuclide Migration Program, 1985--1986 progress report (No. UCRL-53779). Lawrence Livermore National Lab.(LLNL), Livermore, CA (United States).
- Davis, E. L. (1997). Ground water issue: How heat can enhance in-situ soil and aquifer remediation: important chemical properties and guidance on choosing the appropriate technique EPA 600/S-97/502. Washington, DC.
- Dey, N. C., Saha, R., Parvez, M., Bala, S. K., Islam, A. S., Paul, J. K., & Hossain, M. (2017). Sustainability of groundwater use for irrigation of dry-season crops in northwest Bangladesh. *Groundwater for Sustainable Development*, 4, 66-77.
- Elbanna, E., Abou El-Magd, A., Abo Habaga, M., & Abdulla, E. (2020). Economic of drip irrigation system in new reclamation lands. *Journal of Soil Sciences and Agricultural Engineering*, 9(2), 93-101.
- Gad, M. I., El Sheikh, A. E., & El Osta, M. M. (2011). Optimal management for groundwater of Nubian aquifer in El Dakhla depression, Western Desert, Egypt. *International Journal of Water Resources and Environmental Engineering*, 3(14), 393-409.
- Mailhol, J. C., Ruelle, P., Walser, S., Schutze, N., & Dejean, C. (2011). Analysis of AET and yield predictions under surface and buried drip irrigation systems using the Crop Model PILOTE and Hydrus-2D. *Agricultural Water Management*, 98(6), 1033-1044.
- Maraseni, T. N., Mushtaq, S., & Reardon-Smith, K. (2012). Climate change, water security and the need for integrated policy development: the case of on-farm infrastructure investment in the Australian irrigation sector. *Environmental Research Letters*, 7(3), 034006.
- Sikdar, P. K. (2019). Groundwater Development and Management. Groundwater Development and Management: Issues and Challenges in South Asia. Springer International Publishing, Cham, 227-241.

اقتصاديات استخدام نظام الري بالتنقيط في الأراضي حديثة الاستصلاح

حنان فيصل السيد المرسي محمد، الشحات بركات البنا ومحمد مصطفى أبو حبابه

قسم الهندسة الزراعية - كلية زراعة - جامعة المنصورة

المخلص

تهدف هذه الدراسة إلى تقييم جدوى استخدام نظم الري بالتنقيط في الأراضي المستصلحة حديثاً، ومقارنة كفاءته وعبء استهلاك المياه والطاقة والتكلفة مع نظامي الري بالرش والري بالغمر، بالإضافة إلى دراسة الجدوى الاقتصادية لاستخدام الطاقة الشمسية مقابل طاقة الديزل في تشغيل نظم الري. شملت التجارب أربعة محاصيل رئيسية هي القمح والبصل والفول والذرة. أظهرت النتائج أن الري بالتنقيط سجل أقل استهلاك مائي مقارنة بالرش والغمر؛ حيث بلغت كميات المياه للموسم في القمح ١٩٦٠ م^٣/فدان، مقابل ٢٢٦٨ و ٢٥١١ م^٣ لكل من الرش والغمر. وبالنسبة للبصل بلغت ١٤٥٥.٣ م^٣ مقابل ١٥٤٣.٥ و ١٧٧٧.٥ م^٣، وللذرة ١٥٤٢.٢٤ م^٣ مقابل ١٧٦٤ و ١٩١٢.٥ م^٣، وللذرة ٢٢٧٥.٣٥ م^٣ مقابل ٢٥٢٠ و ٢٦٧٣ م^٣/فدان. كما حقق الري بالتنقيط أعلى كفاءة لاستخدام المياه مقارنة بالأنظمة الأخرى خلال الموسم من حيث كفاءة الطاقة، أنتج كل كيلو وات تحت الري بالتنقيط ٥٢.٨٣ كجم قمح، و ٣٨.٥٧ كجم بصل، و ٥٠.٤ كجم فول، و ٤٣.٢١ كجم ذرة، وينسب تفوق نتراوح بين ٥٤٪ و ٦٦٪ مقارنة بالرش والغمر. أجريت مقارنة بين تشغيل نظم الري بالتنقيط باستخدام الديزل والطاقة الشمسية في مزرعة البنا بوادي النطرون، حيث تبين أن التكلفة الأولية للطاقة الشمسية أعلى، إلا أن تكلفتها التراكمية أقل بكثير على المدى الطويل. بلغت تكلفة استخراج المتر المكعب من المياه باستخدام الطاقة الشمسية ٠.٣٥ جنيه مقابل ٢.٢ جنيه للديزل، مع إمكانية استرداد التكلفة خلال العام الأول وتحقيق وفر يمتد لأكثر من ٢٤ عاماً، مما يعزز جدواها الاقتصادية للمزارعين.