Eliminate the Migration of Farmers to Cities by Supporting Renewable Energy Projects

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Abstract—We want to highlight the importance and necessity of using clean energy sources in Iraq, especially in rural and desert areas. After the increase in companies that produce solar cells, this led to cheaper prices and increased efficiency by the manufacturers. In this paper, we present a study that is a good example of the amount of wasted and unfortunately underutilized solar energy. By collecting weather and environmental data for the Al-Rifai area and studying it through the use of the HOMER energy program, we want to propose a solution to stop the migration of farmers from the countryside to the city by supporting clean and cheap energy projects, overcoming the prevailing unemployment and increasing agricultural production. We took an example here of desert land with an area of 100 acres in the city of Al-Rifai in southern Iraq, which suffers from the phenomenon of drought and the migration of farmers to nearby cities, and we found it is possible to produce energy in this place at a very cheap cost (0.0119 $/kWh).

Keywords—solar energy, renewable energy, HOMER program, irrigation, orchard date, economic feasibility

1 Introduction

Iraq is characterized by its hot and dry climates and clay soil, and it is always very suitable for the cultivation of date palms. We note the large spread of date orchards in Iraq, as they are a very important fruit in people's lives because they constitute an economic and nutritional resource for people. Because of the scarcity of water in the Tigris and Euphrates and the high rate of drought, desertification began to appear and increase in a very frightening way as the drought ended the livelihoods of thousands of farmers and large waves of displacement began to cities. So, all this is due to the negligence of many government agencies, as they did not work to develop agriculture and use modern methods, especially the irrigation problem. In this paper, we dealt with the subject in a scientific engineering way and decided to treat the main problem, which is the irrigation problem. We conducted a scientific survey on the orchards of Iraq, with the help of some agricultural experts, and it was found that the main problem is the cost of irrigation. Most farmers use ancient irrigation methods by flooding the lands, on a daily and random basis, by using pumps that operate on fuel (diesel). It is a very expensive fuel at this day and costs about 0.5$ per liter in Iraq, as one palm tree needs about 65 to 70 cubes of water throughout the year [1–6]. Note that Iraq contains huge reserves of untapped groundwater, and according to the opinion of agricultural experts that this water is suitable for irrigation. This survey is summarized around a desert land with an area of about 100 acres, (the acre = 2500 m^2) located in southern Iraq, and to cultivate this land requires an irrigation system, and this needs a pump, and to operate the pump, an energy source must be found. And according to the opinion of agricultural experts, it requires a pump with a capacity of about 20 HP to properly irrigate such an area. In this paper, we will study whether the region is prepared to operate such a pump using solar energy or not, and then compare with operating such a pump if it is running on fuel. The study requires a comprehensive research on the sources of solar energy in the region, using the data provided by the local and international meteorological departments, in order for us to know the economic feasibility of such projects and ideas. And to implement the idea, the well-known HOMER pro. program was used, which deals with accounts and clean energy plants [7–13].

2 Description of project

The project is summarized in the search for renewable energy sources, especially solar energy, in rural and desert areas due to the displacement of people from the countryside to the cities. We took an example in a desert land about 100 acres in the city of Al-Rifai in southern Iraq, and we built a grove of date palms on it. According to the opinion of agricultural experts, we will plant 35 palm trees in each acre. Studies indicate that one palm tree consumes about 64 cubic meters of water throughout the year. And it is consumed more in the summer due to the high temperatures in Iraq, especially in the south, where the palm tree needs 200 liters daily in the summer. To irrigate this area and provide water to the palms, it requires a pump with a capacity of 20 HP and operating from 6 to 8 hours per day [14–17]. The study will be divided into two phases according to the pump operating system and will be as follows:

– The orchard is in the case of a diesel pump;
– The orchard is in the case of a solar pump.

2.1 The case of a diesel pump

It is known that Iraq is very rich in fossil fuels, crude oil and natural gas, as Iraq represents the third reserve in the world. Nevertheless, we note the existence of a crisis in oil derivatives and their high prices, as the price of a liter of diesel around 0.5$. As we mentioned earlier, to irrigate this area, we need a 20 HP pump that works for about 6 to 8 hours almost daily to irrigate the entire area. To run a pump with this capacity, need to 5 liters of diesel per hour of work, meaning more than 40 liters per day. Look at the Table 1 and note the details and operating cost:

Table 1. Cost of diesel pump operation

Item	Cost	Time of Use	O&M/year
Install cost	3000$	25 years	–
Engine	2200$	5 years	1500$
Pump	800$	10 years	300$
Diesel with transport	0.5$/L	Daily	5000$
Oil	2$/L	Each 15 days	250$

2.2 The case of a solar pump

To complete this study, a survey should be conducted around this area to know the quantity and quality of renewable energy (solar energy). For this purpose, we used data provided by local and international meteorological departments such as the NASA space organization. And we got some important data which we will present in sequence:

Average weather in Al-Rifai Iraq. In Al-Rifai, the summers are long, sweltering, arid, windy, and clear and the winters are cool, dry, and mostly clear. Over the course of the year, the temperature typically varies from 7°C to 46°C and is rarely below 3°C or above 49°C.

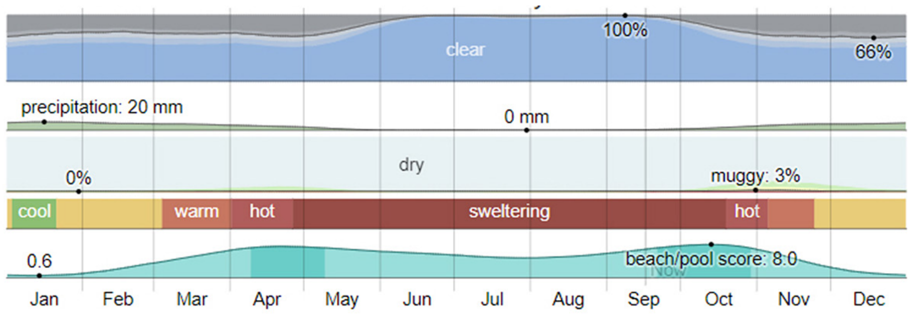

Fig. 1. Average weather in Al-Rifai

Solar energy incident. In this point discusses the gross daily incident shortwave solar energy reaching the ground in Al-Rifai, taking in account of seasonal variations in the length of the day, the elevation of the Sun above the horizon, and absorption by clouds and other atmospheric constituents. Shortwave radiation includes visible light and ultraviolet radiation. The medium daily incident solar energy experiences very seasonal variation over the year. The brighter time of the year continues for 3.5 months, from May 14th to August 25th, with a mean daily incident energy above 7.3 kWh/m². The darker time of the year continues for 3.2 months, from November 1st to February 7th, with a mean daily incident energy about 4.1 kWh/m^2.

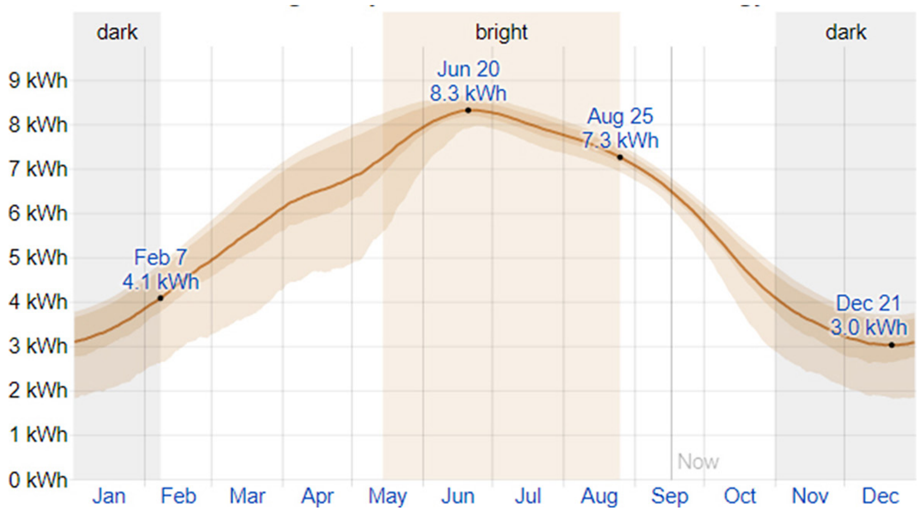

Fig. 2. Average radiation in Al-Rifai

Table 2. Parameters average radiation in Al-Rifai

Parameter(s):															
DNR SRB/FLASHFlux 1/2x1/2 Direct Normal Radiation (kW-hr/m^2/day)															
DNR_MIN SRB/FLASHFlux 1/2x1/2 Minimum Direct Normal Radiation (kW-hr/m^2/day)															
KT SRB/FLASHFlux 1/2x1/2 Insolation Clearness Index (dimensionless)															
DNR_MAX SRB/FLASHFlux 1/2x1/2 Maximum Direct Normal Radiation (kW-hr/m^2/day)															
Lat	**Lon**	**Parameter**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Ann**
31.75	45.75	DNR	4.64	5.2	5.55	5.8	6.92	8.78	8.17	7.71	.15	5.1	4.1	4.16	6.11
31.75	45.75	DNR_MAX	5.67	6.64	7.04	6.86	8.48	10.14	9.21	8.49	8.19	6.54	4.97	5.24	7.29
31.75	45.75	DNR_MIN	3.7	4.12	4.76	4.58	5.2	7.6	7.05	6.26	5.42	4.05	3.07	2.56	4.86
31.75	45.75	KT	0.54	0.56	0.57	0.57	0.62	0.69	0.67	0.67	0.65	0.57	0.52	0.52	0.6
31.75	46.25	DNR	5.17	5.88	5.53	5.57	6.67	8.37	7.78	7.75	6.9	5.13	4.31	4.9	6.13
31.75	46.25	DNR_MAX	5.74	7.7	6.78	6.8	7.82	9.52	8.3	8.49	7.68	6.47	5.14	5.3	7.15
31.75	46.25	DNR_MIN	3.67	4.66	4.61	4.22	5.01	6.38	6.49	6.4	5.17	4.08	3.52	2.9	4.76
31.75	46.25	KT	0.57	0.59	0.57	0.56	0.6	0.67	0.65	0.66	0.64	0.56	0.53	0.54	0.6

It is evident from these accurate data in Figure 2 and Table 1 that the city has a very excellent location in terms of the amount of solar radiation falling on the earth. It is necessary to know the length of the solar radiation period, i.e. the length of the day, in order for us to know the number of working hours for the solar panels and thus know the sufficient irrigation hours for the orchard.

The length of the day. Number of hours in daylight in Al-Rifai varies greatly over the year. In the last year, the shortest day is in December 21th, at 10 hours and 5 minutes of daylight, while the longest day is in June 21th, at 14 hours and 13 minutes of daylight. Look at Figure 3 [18].

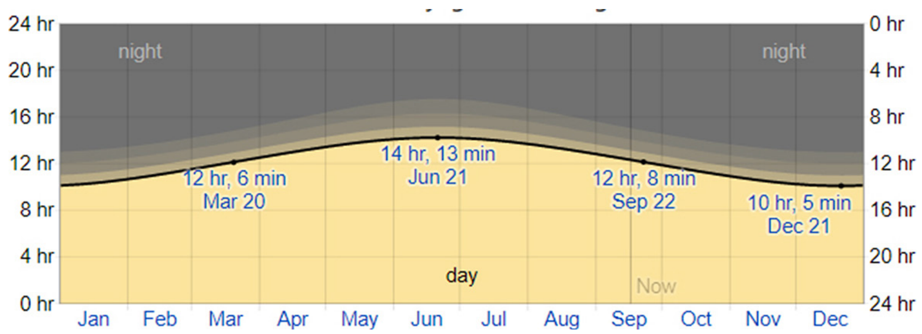

Fig. 3. Average of daylight

Methodology of research. By using program Homer complete case 2, we have chosen solar panels produced by Huawei, with a total capacity of 30 kilowatts, to feed the pump 15 kW (20 HP), and some facilities in the orchard, such as lighting and ventilation, as well as connected to a set of charging batteries, as shown in the figure [8].

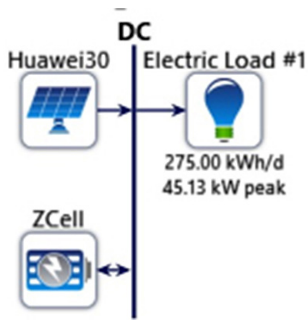

Fig. 4. Solar system in orchard

And after entering the data into the program and running it, we got the following results, which are shown in Table 3 and Figure 5.

Table 3. Electric summary for Huawei SUN2000 30kW with Generic PV [19]

Quantity	Value	Units
Minimum Output	0	kW
Maximum Output	412	kW
PV Penetration	693	%
Hours of Operation	4,387	hrs/yr
Levelized Cost	0.0119	$/kWh
Capital cost	15,563	$
Rated Capacity	388	kW
Mean Output	79.4	kW
Mean Output	1,905	kWh/d
Capacity Factor	20.5	%
Total Production	695,460	kWh/yr

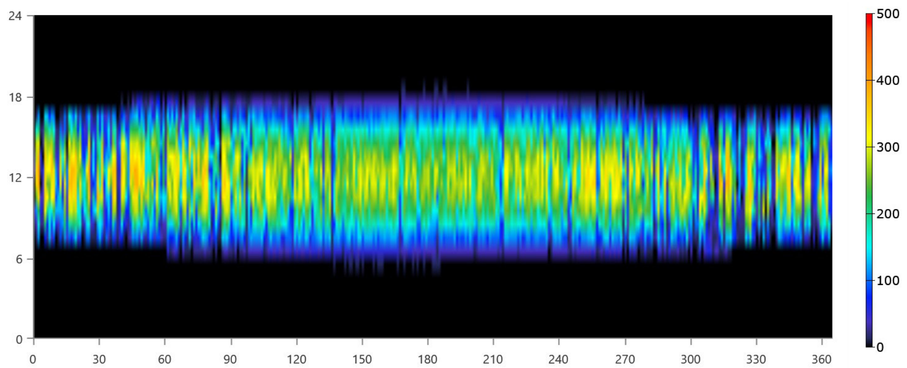

Fig. 5. Power output Huawei SUN2000 30kW with Generic PV (kW)

These previous accurate results show the energy cheapness that can be obtained by using solar panels and the area's ability to provide the solar supply needed to secure the region's energy needs. We will explain how the program calculates the energy produced and the cost, HOMER uses the following equation to calculate the output of the PV array [20–25]

$$P_{PV} = Y_{PV} f_{PV} \left(\frac{\bar{G}_T}{\bar{G}_{T,STC}} \right) [1 + \alpha_P (T_c - T_{c,STC})] \tag{1}$$

Y_{PV} = the rated capacity of the PV array, meaning its power output under standard test conditions [kW];
f_{PV} = the PV derating factor [%];
$\bar{G}_T$ = the solar radiation incident on the PV array in the current time step [kW/m^2];
$\bar{G}_{T,STC}$ = the incident radiation at standard test conditions [1 kW/m^2];
α_p = the temperature coefficient of power [%/°C];
T_c = the PV cell temperature in the current time step [°C];
$T_{c,STC}$ = the PV cell temperature under standard test conditions [25°C].

HOMER defines the levelized cost of energy (COE) as the average cost per kWh of useful electrical energy produced by the system. To calculate the COE, HOMER divides the annualized cost of producing electricity (the total annualized cost minus the cost of serving the thermal load) by the total electric load served, using the following equation:

$$COE = \frac{C_{ann,tot} - c_{boiler} H_{served}}{E_{served}} \quad (2)$$

Where:

$C_{ann,tot}$ = total annualized cost of the system [$/yr];
c_{boiler} = boiler marginal cost [$/kWh];
H_{served} = total marginal cost [kWh/yr];
E_{served} =total electrical load served [kWh/yr].

3 Discussion

Now we compare the results obtained from this survey between operating the pump by diesel and operating by solar panels. The environmental aspect is well known to you, as it has bad environmental impacts that diesel engines leave from burning fuel and waste oils.

Table 4. Compare between the cost of system operations

System of Operation / Years of Operation	Cost by Diesel	Cost by Solar Plat
5 years	Install cost + diesel + oil 5 years + O&M 5 years = 29,250$	Install cost + O&M 5 years = 20,600
10 years	Diesel + oil 5 years + O&M 5 years = 35,000$	O&M 5 years = 500$
15 years	Diesel + oil 5 years + O&M 5 years = 37,000$	O&M 5 years = 500$
20 years	Diesel + oil 5 years + O&M 5 years = 35,000$	O&M 5 years = 500$
25 years	Diesel + oil 5 years + O&M 5 years = 37,000$	O&M 5 years = 500$
Total	173,250$	22600 $

4 Conclusion

Everyone knows the very bad effects of fossil fuels on the environment, and global warming is the best proof of that, and Iraq is one of the countries that suffer from this phenomenon. In this paper we want to prove the economic viability of using solar panels instead of burning fossil fuels. After looking at the results obtained in the tables and figures and the recent comparison, we find that using solar panels is easier, cheaper, and cleaner as an energy source that can be used in Iraq, especially in agricultural lands. And here is a call to decision-makers in Iraq to support agricultural projects by encouraging the use of solar panels as an energy source in addition to granting facilities and reducing taxes on such projects. As we mentioned in the introduction about the suffering of migration from the countryside to the city, and as a solution to these problems, it can be through supporting energy projects and helping farmers to cultivate their lands, overcome the problem of unemployment and increase the agricultural national product.

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