DETERMINATION THE PLANTED AREA BY USING WIND ENERGY

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ABSTRACT

The main aimed of this research estimating planted area of crops by using wind energy. Wind speed for one year in IRAQ used to calculate the wind power, which it regarded as input power of the pump which it used to left the water. In this paper assumed that three values of both diameter of wind turbine(4, 5,6 (m)), and depth of water well(40, 50,60 (m)). The calculations depending on the requirement of each crop to water for middle of IRAQ[8].

The results appear that maximum water amount that can be pumped (12175 m3) in pressure head (40m) and wind turbine diameter (D=4m) through the JULY month and minimum amount was equal to (565 m3) in wind turbine diameter (D=4 m) and pressure head (H=60m) through the NOVEMBER month. The minimum planting area that be planted by vegetable crop equal 18.8 m2 for turbine diameter 4 meter and pressure head 60 meter.

The maximum Area that can be planted by beans crop equals 262 m2, for turbine diameter equal 6 meter, and pressure head equal 40 meter.

Keywords: *irrigation, wind turbine, pumps.*

Nomenclatures

P_{in}	Power products from the Wind	W
A	Cross section Area of the rotor	m^2
D	Rotary Diameter	m
ρ	Air Density	Kg/m^3
V	Wind Speed	m/s
V_∞	Wind Speed out of rotor section	m/s
P_p	Pump Energy	W
Q	Water Flow rate	m^3/s
H	Pressure head (depth of well)	m
T	Hours Number of working Turbine	Hour
Q	Water amount after 5 hours of working	m^3
h_w	Water head required of denoted crop	mm
A_o	Area	m^2

1. INTRODUCTION

Winds used since ancient times as an important source of energy such as ships and wind mills. Then, evolved ideas used slowly despite the lack of energy which it extracted from this field. Since 1933, Champly [1], developed windmills used to generate the electric power, as large capacity. Heys [2] operated on the same principle. Thomas [3], established the first power plant, which it producing energy from winds in America. Thorn [4] studied left water by using rotary axial flow pump, working with wind turbine, ASAAD [5] progress an experimental study, for wind turbine, Svanius type, two-stage, topic on the height of 6 meters and connected to the water pump, he found the performance of the system in practice and theoretically and there was a consensus among the results. Also Lance [6], connecting the wind turbine, horizontal rotation axis to reciprocating water pump and got the produced energy, and flow of water, for different values of turbine diameter, and the pump.

Fathallah et al, [7] have estimated the amounts of water, which can be raised by use wind energy in a manner approximate and combined wind energy with the energy consumption to left the water.

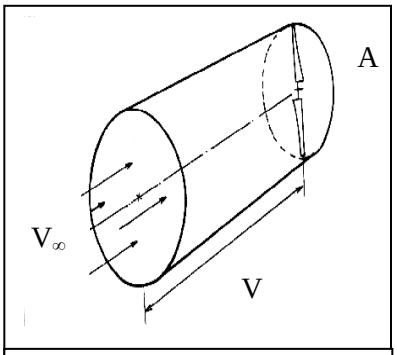
Through previous studies, there are no relationship between the wind energy and planted area of crop, which could be planted by this amount of water, so this would be the research direction, to determine the amount of water that can be pumped by using wind energy in the city of Tikrit in IRAQ. Furthermore, determine the area that could be planted by this amount of water for a some types of crops.

There are some limitations to site selection turbine, and which must be protected from potential barriers, such as plants, forests and buildings, and found that, the height must be appropriate, to overcome the effect of these barriers and in general should be the place where the lowest amount of plants and barriers. The quality of terrain that must be appropriate to increase the speed of wind, as well as the nature of the earth be sufficient to install the turbine and the arrival of trucks for transportation purposes, maintenance and others.
The energy produced from the air flow-rate at **V**, cross-sectional area
A, and density ρ as in Figure (1)

$$P_{in} = 1/2\ (\rho\ AV)\ V^2 = 1/2\ \rho\ A\ V^3 \ldots\ldots\ldots (1) \quad (w)$$

This relationship expresses the following three points.
1 - the energy of the wind depending on the air density (ρ).
2 - The wind energy depending on the area, that which it is Displacement by the rotor blades.
3 - the power depending on the wind speed, which encourages the selection of a suitable site for wind turbine.
when replaced wind speed by that the wind speed out of rotor section eq(1) will be[7].

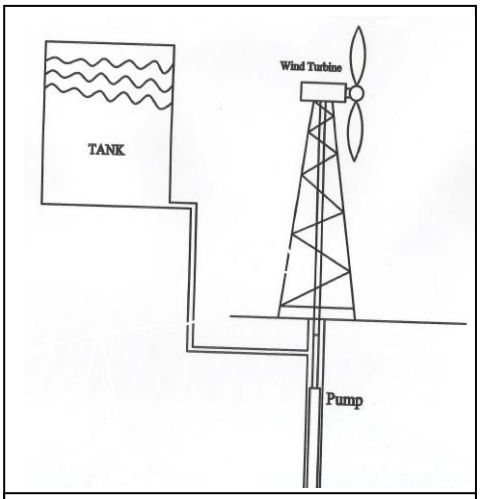
$$P_{max} = 0.59259 * (1/2\ \rho\ A\ (V\infty)^3) \ldots\ldots\ldots\ldots\ldots\ldots (2)$$



Figure(1) Flow of Air at V speed through section A

And the number (0.59259), represents the maximum factor of wind energy, depending on the speed of wind outside blades rotation section and called Betz number [3].
For wind turbine used to raised water, by using wind energy, as in Figure (2) the actual power transmitted from the wind to the water equal [7].

$$Pp = 0.1\ A\ V^3 \ldots\ldots\ldots\ldots\ldots\ldots (3)$$



Figure(1) wind Turbine was linked to water pump and then to water tank

Assuming that, the power that reaches the water pump it is the same power to raise the amount of water from the well (q m^3). were it is equal to[7]

Pp= q ρ g h…….(4)

then

q = Pp / ρ g h…….(5)

The amount of water through (T) interval of working equal to :

Q = q * 3600 * T/1000…….(6)

From equations (3,5, and 6) getting to that

Q = 0.1 A V^3 * 3600 * T / (1000 * 9.8 * h)……(7)

Estimate the planted area

the amount of water sufficient to grew specific crop is very important for the design of any irrigation project. In dry climates conditions and semi-arid regions such as Iraq, where the scarce rainfall and limited irrigation water, from that require utilization of available water, such as groundwater.

And there are many factors are effect to the water amount, and which it sufficient to grow each plant which it

1 - climatic conditions include temperature, relative humidity and windspeed speed and the amount of rain and the intensity of radiation and the brightness of the sun, and others.

2 – required interval to grew specific crop.

3 – Area that covered by water.

4 - The characteristics of the soil

5 - natural factors (terrain and height above sea level, and latitude and longitude)

6 -the irrigation method which will use.

7 - irrigation efficiency.

The researchers [8] put tables to show the requirement of each crop to water for middle of IRAQ (in millimeter per unit area) as shown in table(1).

Where can calculate the amount of required water by the following equation

Q = hw * Ao……..(8)

From this equation Ao equal to :

Ao = Q / hw ……(9) (m^2)

Table(1)the amount of water that sufficient for specific crops in (millimeters) per unit area [8]

months / Crops	Trefoil	Barley	Wheat	Cotton	Sesame	Mash	Forage Crops	Beans	Vegetables	Groves
January	69	65	65	-	-	-	-	52	52	52
February	72	68	68	-	-	-	-	-	54	54
march	98	92	92	79	-	-	-	-	73	73
April	231	115	115	100					93	93
may				151					121	121
June				145	156	156	167		134	134
July				154	166	166	178		142	142
august				145	156	156	167		134	134
September				120	130	130	139		111	111
October	123	115	115					93	93	93
November	90	85	85					68	68	68
December	73	68	68					55	55	55
1 Year	756	608	608	894	608	608	651	268	1130	1130

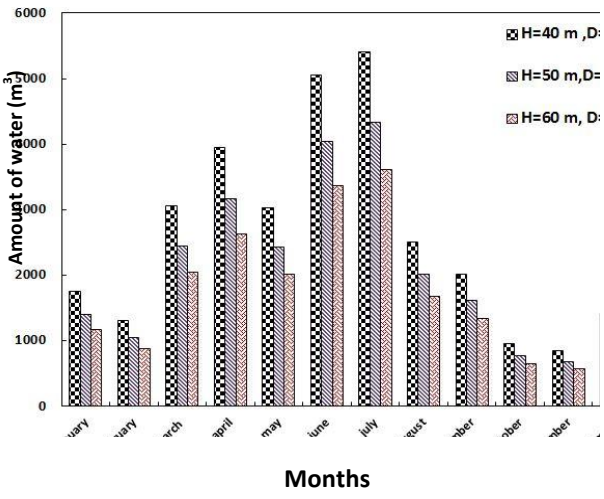
After determined the amount of water (Q) from equation (8) and required of the crop to water (Table 1), can be calculated the planted area of each crop from equation (9).

In this research, we will be assumed three diameters of the wind turbine and three height (depth of a well), (4, 5 and 6 meters) diameter of wind turbine, and (40, 50 and 60meter, depth of the well). The height of turbine assumed to be 10 meters. the speed of wind taken from the Meteorological Department, for one year, and on height (10 meters)[9].

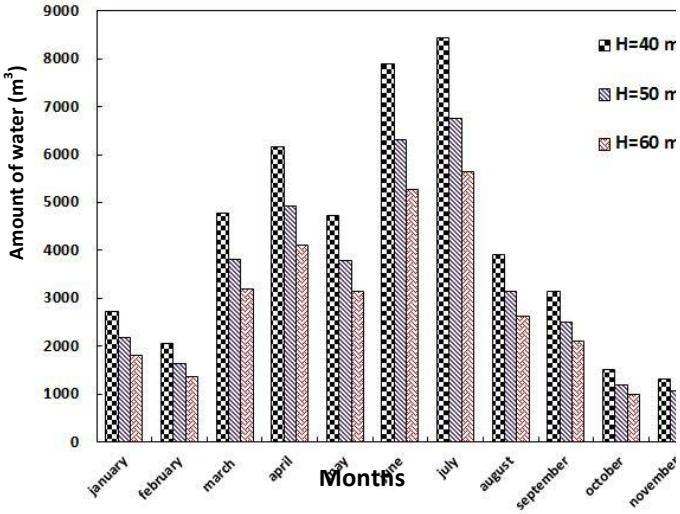
2. RESULTS AND DISCUSSION

The calculations for different values of the turbine rotor diameter, and different pressure head. It can be noticed that the resultants as it shown in figures (3, 4,and 5), which it shown the amount of water that was raised with several values for rotor diameter, and pressure head, for each month, depending on the work interval of wind turbine. Furthermore, the work of wind turbine assumed to be five hours of each Day. As an example from the figure (3) when the rotor diameter 4 meters, and column pressure 50 meters in February month, can be pumped (1049.728m^3) of water.

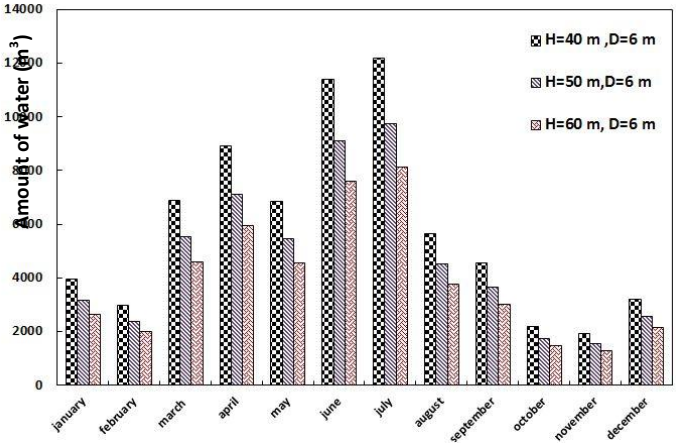
Figures(6, 7,and 8) show the area, which can be planted in (m^2) by different crops for many values of pressure



Figure(3) Amount of Water pumped by wind Turbine(D=4 m, and different pressure head)

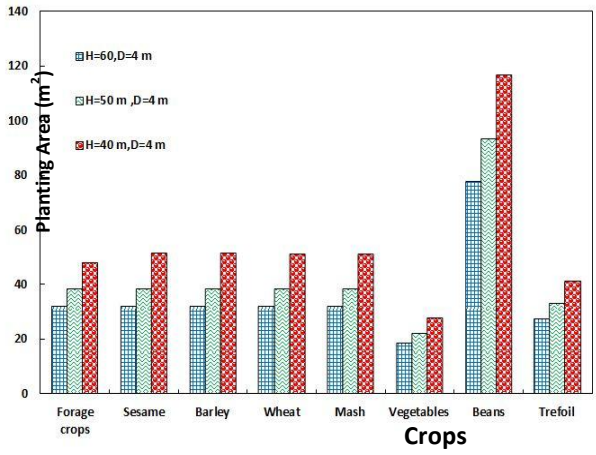


Figure(4) Amount of Water pumped by wind Turbine(D=5 m, and different pressure head)

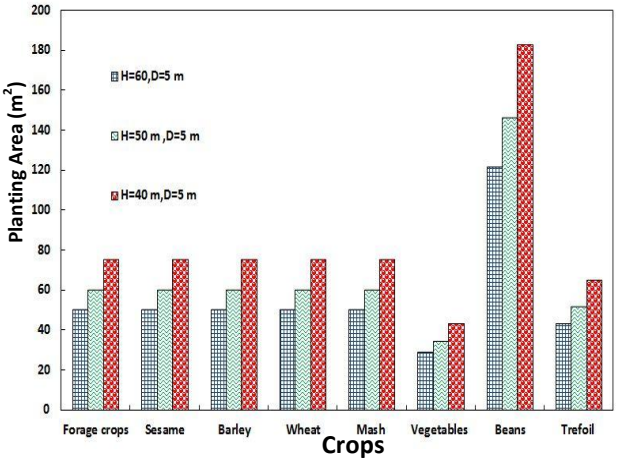


Figure(5) Amount of Water pumped by wind Turbine(D=6 m, and different pressure head)

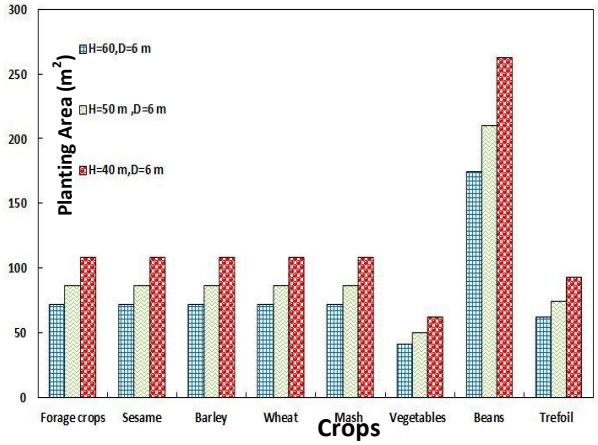
heads and diameters of wind turbine ; for 1, year after connected the pump to a storage tank. Figure(6) at turbine diameter (4 m) and column pressure (50 m), the planting area of beans crop equal (93.5 m2). Also, from figure (8) the area of planting for vegetable can be equal to (62 m2) when turbine diameter (6 m) and pressure head (40).



Figure(6) Area can be planting along the year by specific crop for D =4 m, and different pressure head)



Figure(7) Area can be planting along the year by specific crop for D =5 m, and different pressure head)



Figure(8) Area can be planting along the year by specific crop for D =6 m, and different pressure head)

3. CONCLUSION

The results show that, the wind energy can be used to planting some of the crops in the middle of IRAQ, depending on water requirements for each crop. Also, made experimental model check the results as a recommendation for this research.

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