Water as a Possible Energy Resource to the Shortages in Electrical Power Supply: the Gaza Strip Case

Alaa MA Musalam*‡

*Faculty of Engineering and Applied Art, College of Science and Technology, K/Younis, Gaza Strip, Palestinian National Authority

alaa_musalam@hotmail.com

‡ Corresponding Author; Alaa MA Musalam, Faculty of Engineering and Applied Art, College of Science and Technology, K/Younis, Gaza Strip, Palestinian National Authority, alaa_musalam@hotmail.com

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Abstract- This study investigates how renewable energy resources may well remedy the problems that stem from the shortages in electricity power supply using the Gaza strip as a particular case study. In an attempt to address this research's nature is purely experimental, using the existing laboratory at the College of Science and Technology, City of K/Younis, Gaza Strip. A particular finding emerges in this study which argues for water energy being important because it may well substitute the shortages in energy power supply in developing countries. A hyper station is invented in this study. The aim is not only to produce power electricity from sea water in Gaza, or reduce the cost of energy production but also a desalination of the sea water is achieved.

Keywords- Gaza, power shortages, electricity, desalination, critical.

1. Introduction

Generally, water quantity amounts to three quarters of the earth size; this quantity leads to heat capacity which is as four times as the air, thereby releasing a large quantity of free energy that would in accord to the World Energy Council feed the entire world with pure energy generated from the solar energy. Notably, in case of not using this energy; it spreads out amid the ocean, as Monsieur Girad initiates the basis to mobilize the wheel in 1799 using the sea waves' movements.

Renewable energy has therefore attracted attention worldwide. Indeed, 13.8% of the energy consumed across the world is generated from the renewable energy resources that steadily increases in use and also improves over the time [1]. Albeit in different ways, existing renewable energy resources are classified into four categories [2] as follows: the energy emerged as a result of tidal power; wave convertor; the energy emerging from temperature differences and finally other energy resources, yet under investigation, for example density difference. These categories are all concerned with generating energy only, yet the costs deemed essential in so doing remain at a high level due to continued maintenance [3]. In comparison with the energy produced from fuel, the work on alternative energy [4]; for example sun light and see water, represents an alternative energy that is expected to be less in costs within 10 years' time, thereby reaching 2750 kwh/m^2 per year. Moreover, desalination is possible using thermal processes in an attempt to obtain 500 million m^3/year; sufficient enough to overcome the costly level of traditional energy production.

In response, Mazen Deep [5] develops an innovative approach in an attempt to generate electricity from sea waves in Syria. He found that high and speedy waves of two days per month are sufficient enough to produce 10MW/m^3/s. However, Deep's approach is costly due to the need to perform mechanical maintenance of the machines installed for the project. Vining [6] uses overtopping and states that the driving force to produce energy emerges from the difference of the see level and the filled overtopping.

Nevertheless, the problem lies in the quantity of water that floods from the waves as a result of both size and height - that is, in case the sea waves are not high enough, the energy produced is insufficient because Vining's idea largely depends upon the difference in see water levels in the effort to generate energy.

Nevertheless, hydropower remains an energy resource, reaching 50% out of the total green energy. In essence, the world production of energy reaches 860 GW [2]. By taking into account the steadily increase in fuel prices despite the continued improvements the energy resulted from hydropower is costly effective in the near future [3].

The literature shows that there are two methods commonly used for see water desalination. The first is termed 'Reverse Osmosis' that separates the salt through modified membranes with high pressure 20-50MPa. The second method is called a 'thermal process' which is developed through three stages. The first stage is called multi-effect boiling while the second is multi-effect evaporation. The last is called multi-stage flash. This method is appropriate [7] marked by less in costs.

In summary, the literature related to renewable energy resources, as sketched above, could be summarized as follows:

1. The energy generated from the hydropower fulfil the needs of whole world several times in relation to energy;
2. The production of hydropower energy in comparison with the traditional fuel does not badly affect the surrounding environment due to no emission gases released within the production process;
3. The density of sea water is higher than the air. Therefore, the energy released from the sea waves is multiple doubled [8];
4. The energy released from the sea water largely depends on both the waves' height and also on the latter levels;
5. The heat capacity of sea water is as four times as that of the air;
6. The salt existed in the sea water helps an increase in the costs of engine maintenance;
7. The evaporation released from the sea water is higher than the quantity of rain exited in the Mediterranean area;
8. The sea water could largely absorb the energy heat from the surrounding environment, hence; the former could be considered as a charging battery;
9. The level of generating energy released from the sea water is as twice as that produced by air [6]; and
10. Despite the continued improvements the costs necessary to generate energy from the sea water is still high in comparison with the electricity generated from the oil fuel.

2. Research Objective

How Hydropower, as a Suggested Energy source, could fulfil the Shortages in Electrical Power Supply in the Gaza Strip?

This study therefore advocates alternative energy sources generated from the sea waves. It uses water turbines to generate alternative energy. Its importance lies in reducing the costs deemed essential to generate the required energy. In this respect, the literature [7] uses solar energy in an attempt to generating energy marked by less costs through desalination of the sea water in Gaza. Differently, but related, this study uses sea waves to generate energy and seeks to desalinate water that helps generating this energy in an effort to reduce the costs. In addition, the high rate of evaporation helps accelerate the process of desalination. The solar energy is an effective way to desalinate the water of the Mediterranean to the extent that it is sufficient to provide the whole Arab countries with fresh drinking water [9].

3. Gaza Strip

In the Gaza Strip, the electricity energy has been worsening since 2007 due to the economic siege imposed on the Strip ever since. Its actual need of this energy is 350 Megawatts. In reality, the Strip receives only 217 Megawatts from several donors. In addition, a lack of alternative fuel to diesel emerges. This lack has ever since affected the everyday life in the Strip in relation to mobility, electricity supply and education. Hence, there is a serious lack in energy supply that provokes this study to seek alternatives sources of energy.

Briefly, the Gaza Strip is a coastal area, having neither mountains nor rivers, located on the far eastern part of the Mediterranean, with a total area of 365 kilo meters square. Gaza city is its capital inhabited by 450,000 residents, representing 60% of the total population, that is, 1.600.000 inhabitants in 2009 (Centre for Palestinian statistic). The city of Gaza is of particular importance to this study due to its strategic location, economic and architectural significance. The coastal area of the Strip is almost sandy beaches that are in their almost linear in shape, except around K/Younis city where the coast has curves but returns to its linear shape toward the south until the border with Egypt. In the section that follows, the geology of the coastal area in the Strip is further explored.

3.1. Geology of the Gaza's Coast

The line depth of 100 m is 28 km in the south and 14 km in the north. Immediately after the 100 m sea depth the sea level reaches 1500 m. Note that the average slop of deep sea and the line depth of 100 m is 200/1. This note is crucial in studies related to the Gaza port construction which its length is 730 m and its depth is 11 m (Holland studies prepared for constructing the port). Fig.1 shows six (6) alternative locations suggested for choosing the port, Elsudanya (1), El-Shaty (2), El-Meana (3), Al-Nuseirat (4), Deir Al-Balah (5) and El-Qarara (6) [10].

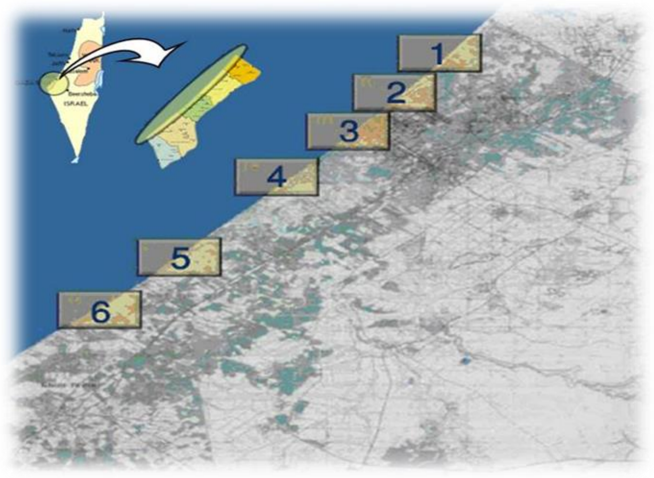

Fig. 1. Six (6) alternative locations suggested for choosing the port

These locations are judged on the basis of sea depth, transportation, safety and density. Location (4) has been chosen for the sole purpose of national security; as other locations are in proximity to pre-Israeli settlements previously existed in the strip. Nevertheless, other locations are stable in relation to sea slop, that is, one meter sea depth for each 80 m. Nevertheless, locations (5) and (6) which are located further south are the best amongst others. In particular, location (6), for example, is featured with a stark slop that reaches 20 m deep in relation to the length (Fig. 2) [11]. Such feature is lacking in other locations.

Fig. 2. Location (6) gives a stark slope in comparison with other locations

As discussed, analysis in this article seeks a practical approach to the energy shortages through the lens of using sea weaves. The energy sources available in the Gaza Strip, for example the sun, wind and water energy, could be used to substitute the shortages in electrical power supply generated from traditional energy sources.

As far as the Gaza Strip is concerned, the energy generated from the water weave's energy is effective mainly because of the very expansive fuel prices in comparison with the neighboring countries, in addition to insufficient energy sources available in the Strip which would fulfill the required demand. The economic siege is blamed because it precludes the imports of goods associated with fuel. As a result, fuel prices sharply increase in the Strip. In this vein, the approach sought in this study has at its core the reduction of cost necessary to generate electricity from sea waves, followed by having fresh drinking water through heat processing through the solar energy. The aim is achieving a decrease in the cost related to producing kilo watts electricity so that this cost becomes equal to that of the energy generated from traditional fuel sources.

4. The Physical and Heat Characteristic of the Mediterranean

Tables 1 & 2 [12], [13], show on the one hand that the thermal characteristics of the Mediterranean Sea when the concentration of salt (35g/kg). These tables also echo the use of sea water to generate pure energy along the seasons of the year without a change in the operational characteristics.

Table 1. The temperature of sea surface C^o

Months	Temperature C^o
December	20
November	23
October	26
September	27
August	28
July	27
June	24
May	21
April	19
March	17
February	17
January	18

Table 2. Physical and Heat Characteristic of the Mediterranean

Property	at 0 C^0	at 20 C^0
Ratio of specific heat C_p /C_v	41	61
Compressibility pas^{-1}	4.65×10^{-10}	4.28×10^{-10}
Thermal expansion coefficient K^{-1}	52×10^{-6}	$250\ 10^{-6}$
Thermal diffusion m^2/s	1.37×10^{-7}	1.46×10^{-7}
Thermal conductivity W/m.k	0.563	0.596
specific heat C_p j/kg k	3985	3993
Boiling point C^0	-	100.56
Electrical conductivity	2.906	4.788

On the other hand, the tidal around the world show disparities. In some case, the highest is in Fundi golf, reaching 15 m in Minas. In other areas, the water level increases and decreases whilst noting the difference tidal power one foot only 30.5 cm. such as the Mediterranean Sea, due to the Mediterranean limited because it is surrounded from all sides.

In the Gaza Strip, there has not been any data that reports about the tidal power. However, the nearest city is Ashdood, 40 km northern the strip, located at latitude 31/50 and longitude 34/38. The tidal power at Ashdood is 01 to 0.6; the zero level is 8.1 cm below sea water, located between 13.6 cm below sea level and 15.1 cm above sea level [14].

Scientist expect due to the change in the climate in the world and rising temperature surrounding environment due the effect of greenhouse, that leads to thermal changes in the physical and chemical of water Mediterranean. Which affects the average sea level rise of 0.4 to 1 m.

In addition, the considered evaporation occurring in the Mediterranean Sea is higher than the rainfall and river water flowing. In particular, causes the decrease in water level and second an increase in salt level in the east.

In turn, these two factors have an impact on water circulation and a large extent coupled with the proportions of evaporation being increased in the eastern part in particular, in addition to an increase in the salt level. Influence push cold water slightly saline from Atlas eastward through Gibraltar, the water causing hotter and higher salinity, then water go down in depths of the East to return again to the west toward the Atlantic in rotational movement causing high waves. That could be utilized to generate energy from motion and height of waves.

From the above we conclude possible to use this increase in thermal properties of sea water in the production of energy and also in the process of desalination, for example, evaporation increased working to increase the volume vapor that take to increase the pressure and heat capacity of water this fact causes us to think about the actual utilization in the production of energy and desalination sea water or find a composite process of energy production and desalination.

The View (Franz T) on desalination of sea water Mediterranean through methods concentration of solar energy to get fresh water, through the possibilities describe it safety and continuous and cheap and large enough to cover the shortage in the Arab States and the Middle East, Desalination experiments proved that per square kilometer of land produces 60Million m^3/year of fresh water [9].

5. Energy Situation in the Gaza

This study suggests a solution to the shortage power in Gaza, which needs at least 350 MW per day, enough needs immediate energy to the Gaza Strip without taking consideration any future increase on energy, The Gaza Strip gets energy from several directions: from Egypt nearly 22 MW and 120 MW from Israel and generate power station 80 MW (Owns the Gaza Strip one station to generate electricity). It is conclude that there is a shortage of 40% of the electrical energy needed by Gaza. Required is to compensate for the shortage of electrical power needed by Gaza, taking into account the change in the amount of energy produced from the station and also the amount of energy that we get from neighboring countries variable.

To undertake practical steps for solving shortage of electric power in the Gaza Strip as a case study by producing energy from the sea of Gaza. should consider the following things: the cost of production of the power plant and the possibilities available material and human resources and ability to implement the project and the recommendations of the scientists that renewable energy is the energy of the future and effective. Therefore we designed a system's composite production of clean energy (Fig. 3), which controlled movement of sea water for the production of energy through the design and construction two pools in deep sea from the beach, by building through a length of 1000 in the sea, the proposed venue for the construction of the project is No. (6) or (5) as shown in Figure 2 which features a very slope down to a depth of 20 m for length in accord to the Holland study.

6. The Energy Generated from Two Overtopping

As shown in Fig. 3, this project consists of two overtopping; the first is at length of 350 m and at width of 100 m and at depth of 20 m. The aim is the transfer of water through turbines to the other overtopping. The latter empties the water in the effort to generate energy through the lens of dynamic energy. This overtopping is larger than the first one, at length of 500 m, width at 100 m and depth at 20 m. Note that the depth does change in the first one but changes in the second overtopping that the latter's depth reaches 10 m. Another note is that there is a change in water depth outside the overtopping starting from the 0 level at beach.

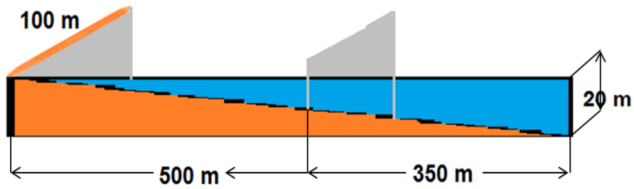

Fig. 3. Two overtopping, the water level and the second for water discharge

The reason for the two overtopping lies in the ability to control the transfer of energy to the second overtopping, in addition to measure the quantity of energy generated from fixed water quantity in the overtopping. Moreover, the water transfer from the first overtopping is at 15 m depth in an attempt to enhance the option of filtering the solid materials, including salt and ferrous sulfate for example. Also, the level of height reaches 30 m including the 20 m using an opening that depends on water level inside the overtopping.

- The quantity of energy measured in Joel generated from emptying the second overtopping E_1;
- The energy generated from the water volume of the waves that their level is above overtopping E_2 measured in Joel

It is possible to obtain the maximum energy as follow:

$$E_{total} = E_1 + E_2 \quad (1)$$

The energy generated is the sum of potential and kinetic energy which depends on the height of the water level in the overtopping (*h*)

$$E = m.g.h + 0.5\, m\, v^2 \qquad (2)$$

It is possible to ignore the kinetic energy in case is the water level in the first overtopping is static

E* is the energy generated in kW

$$E^* = m^* \,[\, g.h + 0.5\, V^2 \,] \qquad (3)$$

$$E^* = f^* \,[\, \rho.g.h + 0.5\, \rho.V^2 \,] \qquad (4)$$

$$E^* = f^* \,[\, P + 0.5\, \rho.V^2 \,] \qquad (5)$$

$$f^* = A.V \qquad (6)$$

*f** :is the average change in water volume.

H :The height level of energy column.

P :Water pressure that depends on water level.

V^2 :The quarter of water speed.

ρ :Water density.

A :The area of cross section to the water pipe of turbine.

7. The Factors Affecting Electricity in Two Overtopping are as follow:

- The ability to empty overtopping 2 and the empty level that affects E_1
- The waves in relation to volume that depends on the sea waves' level that also affects E_2

Having said the above, the generated energy in this project could therefore substitute the needs of energy required in the Gaza Strip in case of Shortage capability or emergency.

8. The Second Part of the Project: suggestion builds a hyper station to produce power electricity from sea water and desalination.

Analysis of this part is concerned with how to empty the water included in the second overtopping, cost effective, as follows:

The water emptied could be therefore used for desalination water. The water included in the second overtopping has a high heat feature enabling the evaporating quantity to be at the maximum. As such, the solar energy could be used as the difference in the temperatures as shown in Table 2 is all through the year. Therefore, the change in the heat feature is almost stable throughout the four seasons. The Gaza Strip critically lacks appropriate sources to offer fresh drinking water. In response, heat analysis is advocated in this study which uses a concentrated sun light. The latter enables evaporating the sea water in an effort to arrive at fresh drinking water, as shown in Fig. 4.

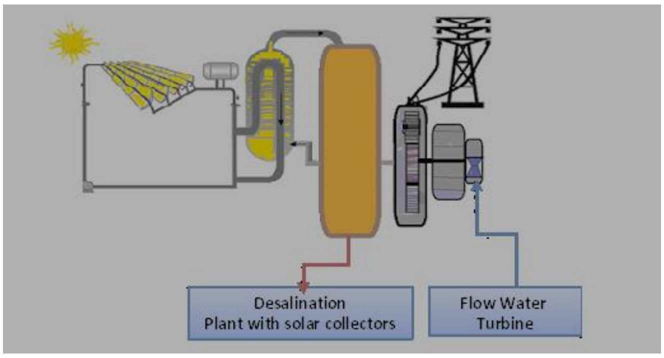

Fig. 4. A hyper station to produce power electricity from sea water and desalination.

This composite system works to reduce costs energy through desalination process water of pool discharge, so that whenever decreased the amount of water in the second pool through: the desalination process, evaporation and low level of pool by the tidal, that increase the amount of energy generated from the power plant water.

for example a low level of the second overtopping using tidal power, estimated at 0.3 m to 0.5 m depth, a possible exclusion of 15000 m^3.

There is the possibility to change the temperature of the water depth in the overtopping to reach 90 C^0 [15]. Such system enables the capacity to store the sun light while noting that the color of the depth is dark to absorb the sun energy, heating the salted water situated deeply. Another note is that the deep water has a high pressure due to increasing its temperature in comparison with the surface. This pressure helps pump the water included in the second overtopping in the designated pipes. Calmed water in this respect offers the opportunity to be evaporated. For example is Aswan water fall, with an area of 5200 km^2 and evaporating degree estimated at 14 km^3 [16].

In accord to the international records, concerned with high waves and mobilized by wind at speed ranging from 10 to 100 KW/m, the energy is generated upon the sea waves' height, its length, duration and the speed frequency. The Mediterranean area and North African coast, for example, show a record of generating energy that ranges between 10 and 20 KW/m, whilst noting that the climate enhances the opportunity in these particular areas to generate energy from sea wave's movement [17]. Moreover, waves that are far away from the beach show an increase level of generated energy. However, all these ideas remain under investigation, including those commercial ones [18]. The cost of one (kw) is a critical factor in this project which is estimated to be between 400 and 600 US Dollars, excluding the maintenance and operation costs for the first two years [19]. In this vein, desalination adopted here helps reduce the costs to the half to the extent that the costs calculated upon two years will be much less than that generated in the central electricity power station.

Nevertheless, waves naturally are varied in relation to height marked by being chaotic. The key aspects necessary to observe the height and strength of the waves represented in the energy column (H) and time period (T) are as follow:

P is power per unit length of wave front (W/m)

$$P = \frac{F.C.T}{8\pi.a} \quad (7)$$

$$F = \rho.a^2.H.T^{-2} \quad (8)$$

F: force of water wave

P: density of the water (kg/m^3)

C: gravity (m/s^2)

a: amplitude of water wave (m)

T: Time period of wave (s)

H: high wave (m)

Overall, in case the sea waves are large in size the generated energy for each meter is enhanced. Also, this energy is determined by waves' strength, speed and the time at which such waves occur.

The results of the energy generated by the turbine nearly 70 to 120 MW dependent on the production of drinking water from the desalination process .Possible to build another stations to increase production if that necessary .

9. Conclusion

1. The heat properties that characterize the Mediterranean Sea in the Gaza Strip, we can exploit it to generate renewable energy with high efficiency;

2. The water energy is an important source to generate alternative energy, especially in Gaza Strip to compensate for the shortage of electrical power;

3. It is feasible to reduce the high cost of construction of a hydropower station through the desalination of sea water output from the generation process through solar collectors;

4. It is also feasible to establish several water energy stations in the Gaza Sea to increase production, electricity generation and water desalination

5. The more water quantity output from desalination increased the amount of energy produced and decreased cost of kilowatt;

6. The station composite is an effective way to produce cheap energy from sea water through the utilization of solar energy for water desalination.

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