

Potential of Solar Water Distillation for Integrated Renewable Energy Farms



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Importance of Renewable Energy for Fresh Water Production

The availability of potable water is an important problem for the communities who will be lived in arid new regions or especially for people in remote region (Bedouins). These regions are recognised by a high intensity of solar radiation, which makes the direct use of solar energy represents a promising option for these communities to reduce the major operating cost for pumping drinking water. Jordan is one of the countries that face the energy shortage problem also the shortage in fresh water source.

In many regions of the world especially Middle-East, desalination has become a most reliable source of fresh water. The different methods used in desalination are based on thermal or

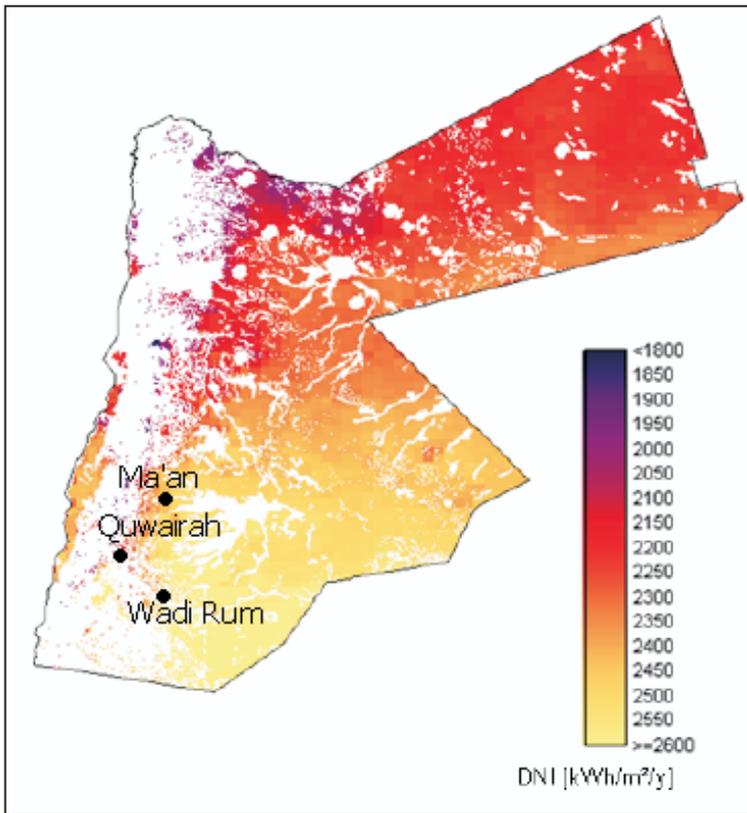


Figure 1: Jordan Solar Map

membrane principles. Among the thermal methods used is solar distillation. Interest in solar distillation stems from the fact that areas of fresh water shortages have plenty of solar energy such as Jordan. Moreover, its low operating and maintenance costs made it an attractive method in areas away from the electricity grid lines. But most of them suffer from low productivity which put forward an initiative to look for ways to enhance its productivity and efficiency. Solar distillation is one of the available methods for water distillation, and sunlight is one of several forms of heat energy that can be used to power that process. In the present case study different designs of solar stills (i.e. cylindrical parabolic and simple sun tracked solar stills) can be suggested to be used for Integrated Energy Farms (IEF) with an innovative electro-mechanical sun tracking system to enhance the production.

Solar Energy Application in Jordan

Neither gas nor petroleum can be produced in commercial amounts in Jordan, this makes Jordan depends totally on imported oil for producing its required energy. As a consequence, a high petroleum bill is to be paid by the country every year, this forced researchers and establishments in Jordan to think seriously of the Integrated Renewable Energy Farms (IREF) projects to solve this problem totally or partially. Dealing with renewable energy systems, theoretical studies and research started in Jordan in 2004. Some years later, it came to some applications of Renewable energy systems. As part of its policy to reduce dependence on fuel and gas imports, Jordan has developed programs to promote renewable energy. The country is well served for solar energy resources (Figure 1), and the government has set a target of acquiring five per cent of total energy needs from renewable energy by 2015.

Water Desalination Using Solar Energy

One of the most important usages of solar energy is in supplying fresh water especially in water scarce countries such as Arab countries which are poor in fresh water sources but rich in sunshine (Figure 2). Most Arab countries have experimented with solar desalination.

Case Study Concept

The concept of an Integrated Renewable Energy Farm (IREF) which will be implemented in a village in the southern part of Amman, is a farming system model with an optimal energetic autonomy including food production and, if possible, water and energy exports. Energy and fresh water production and consumption at the IREF have to be environmentally friendly, sustainable and ultimately based mainly on renewable energy sources. It includes a combination of different possibilities for non-polluting energy production, such as modern wind and solar electricity and fresh water production, as well as the production of energy from biomass (Figure 3). An integrated energy farming system based largely on renewable energy sources would seek to optimise energetic autonomy and an ecologically semi-closed system while also providing socio-economic viability and giving due consideration to the newest concepts of landscape and biodiversity management of water and energy. Ideally, it will promote the introduction of different renewable energies, promote rural development and contribute to the reduction of greenhouse gas emissions and water scarcity, Figure 3.

Solar distillation application in the IREF for the populations living in arid areas of southern Jordan and Badia is recommended due to the shortage of potable water and due to its simple technology and low cost, which can be easily adopted by local rural people. Solar distillation can be used to convert the available saline or brackish water into potable water economically. Jordan has high solar radiation as far as utilisation of solar energy is concerned. Also Jordan has an excellent mean solar radiation on horizontal surfaces of 5.5-6kWh/m²/day compared with that of Europe and most of North America, which amounts to 3.5kWh/m²/day, ie, about 60% of that falling over a square meter in Jordan. Also the solar isolation in Jordan occurs for about 2000-3000 sunshine hours in a year. Recently different designs of solar still have emerged. The single effect solar still is a relatively simple device to construct and operate. However, the low productivity of such solar still leads one to look for ways to improve its productivity, and efficiency. Earlier, it was also found that the sun tracking methods can increase the solar still capability to capture more solar energy to be used later for higher production.

These studies were behind the idea of this case study, and the need for a research work to do more investigation on utilising the solar distillation devices to be used later with the Integrated Energy Farms for arid regions.

Effects of system design and climatic parameters, on the performance of the system are important factors. It has been established that the overall system efficiency in terms of daily distillate output will increase by decreasing the water depth and the use of latent heat of condensation for further distillation. Further, increasing the temperature difference between the evaporating and the condensing surface can increase the daily distillate output of passive solar through the trough pipe. The

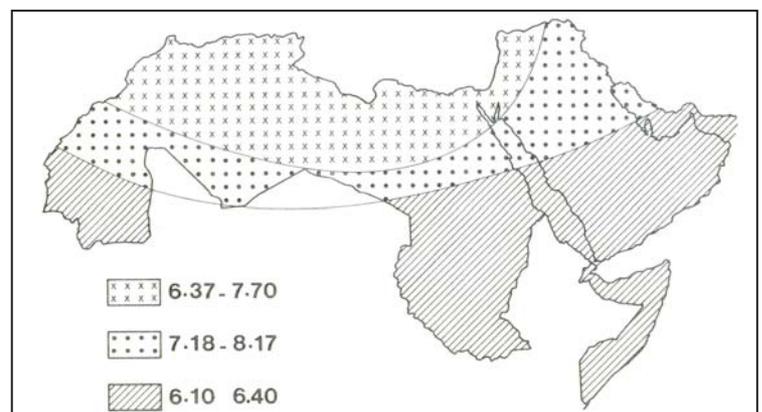


Figure 2: Average Maximum Arab Countries Radiation, kWh/m²/d

