A COMPARATIVE STUDY ON 3E (ENERGY, EXERGY, AND ECONOMIC) ANALYSIS OF SOLAR PV OPERATED DOME-SHAPED SOLAR STILLS

by

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The present investigation centers on the empirical examination of a solar photovoltaic system that is integrated with a dome-shaped solar still in order to facilitate the process of desalination. The objective is to increase the production of freshwater through the utilization of saline water at elevated temperatures. The assessment of the dome-shaped solar still system's efficacy is conducted through the examination of various parameters, including water yield, energy, exergy, concentrator performance, and economic feasibility. The study's results demonstrate that the dome-shaped solar still system's water yield, energy, and exergy were evaluated under varying inlet temperatures and mass flow rates. The study recorded the water yield, energy, and exergy at 4.73, 4.27, and 4.91 L per m², respectively, with respect to the ambient inlet temperature. The water yield was observed to range from 6.9-7.7 L per m^2 under different input temperatures and air mass-flow rates. The dome-shaped solar still system's energy and exergy efficiency were evaluated, indicating encouraging results for various inlet air temperatures. Furthermore, the economic evaluation revealed that the rate of freshwater production was cost-effective in comparison to conventional solar stills. In summary, this research offers empirical proof of the efficacy of a solar photovoltaic - powered dome-shaped solar still for the purpose of desalination. It emphasizes enhancements in the output of fresh water, energy and exergy efficiency, and the economic viability of this technology.

Key words: *photovoltaic performance, dust deposition, power losses, tilt angle, solar irradiance*

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Introduction

The availability of viable water resources is a fundamental necessity for the sustained development and survival of all organisms. Regrettably, the global accessibility of uncontaminated water is declining at a concerning pace. The vast majority of the Earth's surface, approximately 96.54%, is comprised of saltwater, while only a small fraction, approximately 0.36%, is freshwater. The remaining freshwater is primarily stored in glaciers and polar caps [1-3]. The exponential growth of the world's population and the swift pace of urbanization have resulted in a significant escalation in the requirement for water, leading to the imprudent depletion of our finite water reserves. The current state of affairs presents a significant peril of limited availability of freshwater to the human population. As a result, there is an urgent need to investigate viable approaches for generating fresh water from polluted sources [4, 5]. Desalination of contaminated water is considered a feasible approach to address the increasing global need for freshwater, given the range of available methods. Advanced techniques, including membrane distillation, humidification-dehumidification, reverse osmosis, and multistage distillation units, are employed in large-scale commercial desalination systems to improve freshwater productivity [6, 7]. Notwithstanding, these systems generally depend on centralised units and necessitate advanced infrastructure, rendering them unfeasible for rural and remote regions. Passive desalination devices that are small-scale and require low-maintenance can be instrumental in meeting the freshwater demands of local communities and enhancing their living standards. The solar still (SS) is an instance of a proficient passive desalination mechanism. The SS are a straightforward yet remarkably effective means of transforming impure water into potable water. Nevertheless, conventional SS encounter optical losses that have a negative impact on the efficiency of the collector [8, 9]. In order to address these constraints, scholars have put forth diverse methodologies to augment the water output and comprehensive efficacy of solar distillation units via structural alterations. The objective of these endeavors is to enhance the efficiency of SS, with the ultimate goal of increasing their efficacy in generating potable water from polluted sources. The exploration of innovative solutions is crucial in addressing the urgent problem of freshwater scarcity. Passive desalination technologies, such as SS, have significant potential in facilitating decentralized access to clean water, particularly in remote and rural regions [10]. The mitigation of optical losses in such systems can lead to a substantial enhancement in water yield and efficiency, thereby facilitating the provision of a sustainable water supply to communities that are in dire need. Numerous research endeavours have been conducted to explore diverse alterations and augmentations to SS with the aim of enhancing their efficiency and amplifying water yield. Kabeel and Abdelgaied [11] conducted an empirical investigation to assess the effects of a latent thermal energy storage material in conjunction with a spherical concentrator on the production of potable water. In their study, the researchers utilized paraffin wax as a phase PCM and integrated a parabolic solar concentrator with a SS. This approach resulted in enhanced thermal properties and a higher yield of water production, as reported in their findings [12].

The utilization of a solar concentrator combined with PCM resulted in a significant enhancement of the daily production rate of potable water by 55-65% and 35-45% throughout the summer and winter months, respectively, in contrast to the utilization of a conventional SS. The enhanced performance was attributed to the synergistic impact of PCM and concentrator, which resulted in an elevation of the temperature of brackish water and a subsequent acceleration of the evaporation rate. Diverse approaches have been investigated by scholars in order to improve the efficiency of SS. Chauhan and Kumar [13] implemented a strategy to elevate the internal temperature of the dryer by integrating northern walls. Similarly, Prakash and Kumar [14] utilized a black poly vinyl chloride sheet to cover the drying platform, thereby increasing the internal temperature and decreasing humidity within the dryer. In their experimental investigation, Mateen *et al.* [15] explored the application of metal oxide nanoparticles as a coating material to enhance the edge emission of solar concentrators. The results of their study revealed a significant improvement in the overall power efficiency of the concentrators, with a 10.37% increase compared to conventional concentrators. In a study conducted by Elashmy and El-Said [16], gravel was utilized as a medium for energy storage in a SS that was coupled with a parabolic concentrator solar tracking system. The study observed that the use of gravel proved to be highly effective in achieving optimal performance of the SS. In their study, Vigneshwaran *et al.* [17] conducted an experiment utilizing a greenhouse solar dryer to desalinate water through the process of humidification and dehumidification. The results showed a water yield of 350 g per liter over a period of 2.5 days. The study revealed that the implementation of a roof-even type greenhouse evaporator resulted in a 43% reduction in the necessary land area for the dehydration of 1 m^3 of tannery effluent. The study conducted by Kannan *et al*. [18] examined the efficacy of hemispherical-shaped SS that were integrated with square and triangular patterns. The results indicated that the square pattern generated a water yield of 5.63 kg/m^2.

Despite the advancements achieved in the domain of solar desalination, a significant lacuna in research persists concerning the efficacy of conventional SS. The extant body of literature indicates that conventional SS generally demonstrate a water yield of up to 5.63 kg/m^2, concomitant with a maximum energy efficiency of 65%. The aforementioned statistics suggest that there exists considerable scope for additional enhancements in said systems. The current study aims to fill the existing research gap and advance the field of solar desalination technology by incorporating geometrical advancements. A solar PV panel-operated air heater was integrated with a DSSS system, which was designed and fabricated. The researchers' objective is to improve the efficiency of SS through the utilisation of the suggested geometrical alterations. The utilisation of a dome shape presents certain benefits, including heightened surface area for the absorption of solar radiation, enhanced efficiency of condensation, and optimised air-flow dynamics within the system. Furthermore, the incorporation of a solar PV panel-driven air heater presents an added energy source that has the potential to enhance the rate of evaporation and the overall production of freshwater. The project aims to close the research gap by evaluating potential enhancements in water yield and energy efficiency relative to conventional SS through the construction and testing of this novel dome-shaped solar still (DSSS) device. The researchers aim to provide valuable insights to the field of solar desalination and facilitate the development of more efficient and effective water production methods by concentrating on the integration of geometrical advancements and the utilization of solar PV panels for an air heater.

Experimental test facility

Figure 1(a) depicts the experimental test facility situated on the rooftop of the Mechanical Department at Askahaya College of Engineering. The experimental testing facilities comprise a set of components, namely a solar panel, a battery, a blower, a heater, a direct-sequence spread spectrum (DISSS) system, and resistance temperature detectors (RTD). A solar evaporation unit (SEU) possessing an aperture area of 1 m^2. The absorber plate utilized by SEU was constructed from galvanized iron and coated with black paint, measuring 1 m in length, 1 m in width, and 0.05 m in thickness. A dome structure composed of poly carbonate material was utilised to fully cover the absorber surface, reaching a height of 0.3 m.

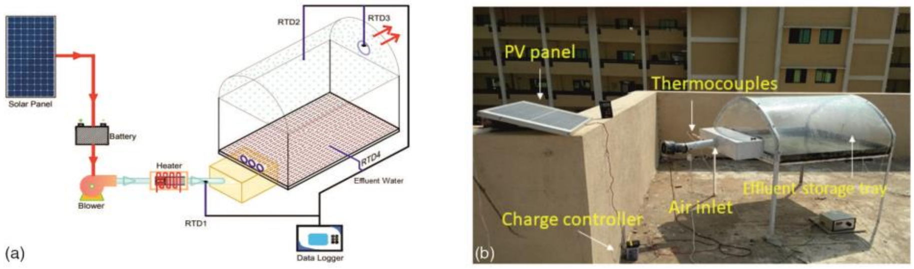

Figure 1. (a) Schmatic of experimental set-up and (b) photographic view of experimental set-up

The implementation of a dome structure facilitated the amplification of the greenhouse effect through the utilisation of effluent water, while simultaneously impeding the descent of distilled water into the basin. A set of four *J*-type thermocouples were employed to measure the temperature at the inlet and outlet of the dome structure, as well as the surrounding and effluent water surfaces. Wind velocity and solar radiation were measured by means of an anemometer and a pyranometer, respectively, which were installed in close proximity to the surface of the experimental test facilities. Table 1 presents the measuring characteristics of the instrument utilised for the solar panel.

The experiment was conducted at co-ordinates 12.9698ºN-18.1943ºS with an orientation in the East-West direction. At the onset of the experiment, preheated air was supplied to the SEU unit via a blower, with intended velocities of 1 ms^{-1}, 2 ms^{-1}, and 3 ms^{-1}. The preheated air within the dome structure experiences an increase in its relative humidity values, leading to condensation at the uppermost part of the structure. The regulation of the blower was facilitated by a regulator, while the blower system was powered by solar batteries. The experiment was conducted for a duration of six hours. Figure 1(b) displays a photographic representation of the experimental arrangement.

Table 1. Specification of measuring devices

Devices	Specification	
Temperature measurements	Copper Resistance Temperature Detectors Accuracy: ± 0.01 Ω at 0 °C Stability: –200-260°C	
Flow measurements	Water Rotameter Accuracy: (± 2% to 3%) Working temperature: up to 95 °C Flow rate range: 0 to 200 Lpm	
Solar radiation	Pyranometer (Kipp and Zonen - CMP 3)	
	Spectral range (overall)	400 to 1100 nm
	Sensitivity	60 to 100 μV/W/m²
	Response time SP Lite2 (95%)	< 500 ns
	Directional response (up to 80° with 1000 W/m² beam)	< 10 W/m²
	Temperature response SP Lite2	< –0.15 % per °C
	Operational temperature range	–40 °C to +80 °C
	Maximum solar irradiance	2000 W/m²
	Field of view	180º

Results and discussion

Temperature variation and yield analysis of dsss for various flow rates

Hourly measurements of solar radiation and temperatures were taken at different points within the SS system as part of the study. The extensive gathering of data facilitated a thorough examination of the correlation among solar radiation, temperature patterns, and the resultant production of freshwater. The distilled water output of the SS under different test conditions is depicted in fig. 2, which illustrates the fluctuation of radiation over the course of the day. The data indicates that the highest levels of solar radiation were recorded during the period between midday and 1:00 p. m., with a subsequent gradual decline towards the evening. At a mass-flow rate of 3 Lpm, the absorber plate, lower glass basin, and upper glass basin attained their highest temperatures, measuring 74 °C, 69 °C, and 61 °C, respectively. The results indicate that the absorber plate exhibited the highest temperature readings compared to other locations within the DSSS system. The absorption of solar energy by the glass surface results in an elevation of water temperature, thereby causing evaporation and consequent formation of a vapour layer on the inner glass surface. As a result, the temperature profile of the inner glass surface is observed to be the second highest, with the outer glass surface following closely behind. The optimisation of natural circulation and condensation is essential for maximising the freshwater output, and this is dependent on the temperature differential between the water basin and the bottom glass surface. The present investigation revealed that the glass lower surface and absorber plate manifested a peak temperature differential of 8 °C at 1 p. m. as a result of the mass flow rate of 3 Lpm. This phenomenon augmented the rate of condensation and subsequently increased the hourly freshwater yield. The temperature fluctuations of the absorber plate, lower glass, upper glass, and ambient air are depicted in fig. 3 under a flow rate of 2 Lpm. The mean environmental temperature was documented as 33 °C. As solar radiation intensified, the absorber plate, lower glass, and upper glass temperatures correspondingly rose, culminating in their maximum values at 1 p. m. It is noteworthy that the temperature differentials observed across the junctions exhibited a significant decrease with the decrease in flow rate in the DSSS system. The reduction in the flow rate causes a deceleration in the increase of water temperature, subsequently resulting in a decrease in the rate of water evaporation from the basin onto the glass surface. The reduction in the rate of evaporation results in a decrease in the quantity of freshwater accumulated from the glass surface. The study revealed a maximum freshwater yield of 0.55 L per hours at 1 p. m., as depicted in fig. 4. Nonetheless, the highest possible output obtained was roughly 10% inferior to the output attained when the flow rate was set to 3 Lpm. The study determined the daily freshwater yield to be 4.38 L per m^2. The findings indicate that reduced flow rates lead to diminished evaporation rates, leading to a 12% decline in the total daily freshwater supply when comparing a flow rate of 3 Lpm to 2 Lpm. The aforementioned results lead to the inference that elevated mass-flow rates exhibit a positive correlation with amplified freshwater output owing to the aug-

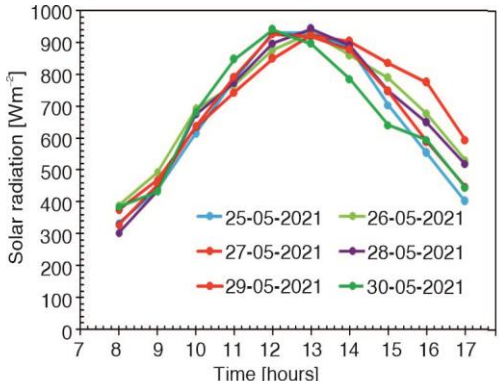

Figure 2. Hourly solar radiation at various test conditions

mented heat transfer coefficient. The coefficient in question serves to augment the pace at which thermal energy is conveyed from the basin to the glass top in a condensed state, thereby resulting in a rise in the output of potable water. On the other hand, a reduction in the flow rate results in a decrease in the quantity of freshwater generated, along with a decline in the pace of thermal conduction from the basin to the glass interface. The aforementioned observations underscore the significance of maximising the mass-flow rate during the planning and execution phases of solar still systems. Through meticulous flow rate management and control, researchers can optimise heat transfer and evaporation processes to attain greater freshwater yields. The aforementioned observations provide valuable contributions towards enhancing comprehension of the determinants that impact the generation of freshwater in DSSS, and can facilitate the development of more proficient and productive mechanisms.

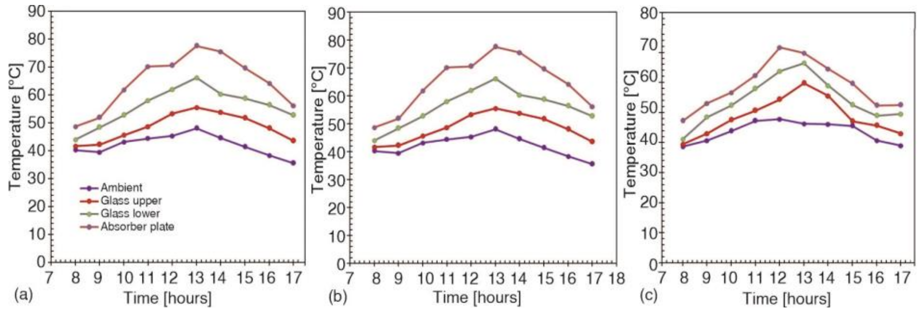

Figure 3. Temperatures variation of DSSS; (a) 3 Lpm, (b) 2 Lpm, and (c) 3 Lpm

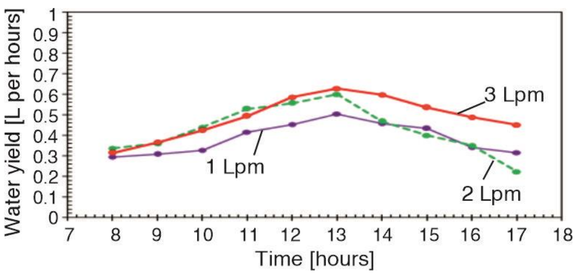

Figure 4. Fresh water yields at different flow rate

Temperature variation and yield analysis

The current study employed a newly developed Direct Sequence Spread Spectrum (DRSSS) system to enhance the overall performance at inlet temperatures of 50 °C, 60 °C, and 70 °C, while maintaining a flow rate of 3 Lpm. Apart from the solar radiation directly incident on the water basin, the SS also received energy from the air that was blown into the basin as it traversed through the system. The majority of solar radiation was converted into thermal energy through the utilization of black paint on the surface of the water basin. This thermal energy was subsequently transferred to the brackish water, glass tubes, and glass top. The temperature differential among the different DRSSS components was significant, as illustrated in figs. 5(a)-5(c).

Figure 5 illustrates the temperature fluctuations of the DSSS at different locations, such as the brackish water in a SS, the upper and lower glass surfaces, the absorber plate, and the ambient air. This pertains to a DSSS with an inlet temperature of 70 °C, fig. 5(a). At the highest ambient temperature, it was observed that the absorber plate, glass lower, and glass upper attained maximum temperatures of 85 °C, 80 °C, 73 °C, and 67 °C, respectively. The temperature of the water within the air heater experienced a significant increase due to the passage of air. The peak performance obtained at each junction in DSSS can be attributed to the provision of preheated air, which facilitated further heating of the brackish water within the system. This, in turn, led to an increase in the natural circulation within the still and a higher rate of condensation. The augmented freshwater yield was assessed as a consequence of the elevated temperature of the absorber plate, which led to amplified rates of evaporation and condensation within the still. Figure 6 illustrates the maximum hourly distilled water output of 0.89 Lpm at 1 p. m., indicating a 39% enhancement compared to the DSSS SS that employs ambient inlet temperature. In contrast to DSSS operating under ambient temperature conditions, the freshwater yield over a full day at a temperature of 70 °C exhibited a higher value of 6.58 L per m^2 per day, as compared to 2.58 L per m^2. The findings indicated that the incorporation of a solar panel-powered air heater has the capacity to substantially enhance the output of freshwater. Figure 5(b) displays the temperature curve of the DSSS, assuming an intake temperature of 50 °C. The absorber plate, lower glass, and upper glass temperatures were recorded as 79 °C, 69 °C, and 57 °C, respectively. The phenomenon of reducing the maximum temperature attainable across the junctions in the DSSS is a well-established fact that occurs as a result of a decrease in the inlet temperature. This can be attributed to the comparatively lower relative humidity in the air at lower inlet temperatures, as opposed to when the inlet temperature is maintained at 70 °C. As indicated by fig. 6, the highest output of freshwater was recorded at 1 p. m., reaching a rate of 0.71 L per hours. This value represents a notable increase of 36% in comparison to the initial temperature input of 50 °C. An observation was made of a daily freshwater yield of 6.21 L per m^2 over the course of the entire day. The decrease in relative humidity led to a lower heat transfer rate, which in turn caused a reduction in input temperature from 70 °C to 50 °C. This resulted in a 6.7% decrease in the overall daily production of freshwater. However, in comparison to the yield output observed at an input air temperature of 70 °C, the results were discouraging. Figure 5 depicts the fluctuations in temperature within the given instance of 50 °C, fig. 5(c). The absorber plate, lower glass, and upper glass surface recorded peak temperatures of 73 °C, 64 °C, and 57 °C, respectively. The maximum ambient temperature was attained at 1 p. m. The empirical evidence indicates that a decrease in input temperature leads to a deceleration of both evaporation and condensation processes, attributable to a reduction in heat transfer caused by a decrease in relative humidity. The rise in temperatures observed at different junctions can be attributed primarily to the supplementary energy supplied by the air heater. The implementation of a 70 °C intake temperature in the DSSS system, as illustrated in fig. 6, demonstrated advantageous outcomes in attaining the highest freshwater production of 0.76 L per hours. The current findings indicate a significant rise of 36% in peak hour yield in comparison to the prior scenario, wherein an inlet mass-flow rate of 3 Lpm was employed at ambient temperature. The quantification of distilled production yielded a daily output of 5.89 L per m^2.

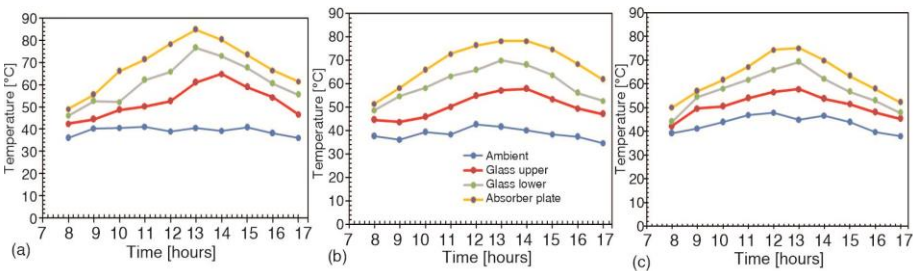

Figure 5. Temperatures variation of DSSS at various inlet temperature; (a) 70 °C, (b) 60 °C, and (c) 50 °C

The study found that a reduction of 50 °C in the heat transfer fluid (HTF) resulted in a decrease of 10% and 4% in the full-day freshwater production, as compared to inlet temperatures of 70 °C and 50 °C, respectively. The results suggest that the conveyance of HTF at elevated temperatures can substantially enhance the output of freshwater from the DSSS set-up. The implementation of a preheated HTF expedites the process of evaporation within the dome, resulting in an increased yield of distilled water. The absorber plate's surface area in a SS system is a critical factor in the heat transfer rate during the water basin's evaporation to the glass surface. Furthermore, the temperature of the water basin, glass surface, and ambient air exert a substantial influence on the rate of vaporization. The rate of evaporation from the basin to the condensed surface is significantly increased when the air temperature in the basin is preheated or elevated, resulting in a substantial increase in the production of distilled water. The aforementioned results highlight the significance of regulating and enhancing temperature management in the DSSS framework. Through the manipulation of inlet temperature and utilization of preheated air, researchers can enhance freshwater yields by facilitating efficient evaporation and condensation mechanisms. The effective heat transfer in the system design of DSSS technology is contingent upon careful consideration of the absorber plate's surface area. Such insights are instrumental in advancing the potential of this technology to improve freshwater production in regions with restricted access to clean water. Table 2 shows the quality of water before and after treatment for two different water samples.

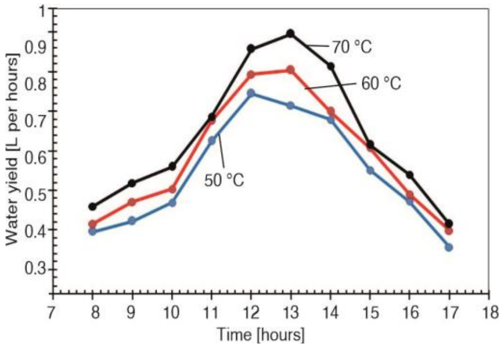

Figure 6. Fresh water yield from the DSSS system

Table 2. Tested water quality of effluent water

No.	Water quality parameters	Before treatment [mgL^{-1}]	After treatment [mgL^{-1}]	Accepted standards
Sample 1				
1	TDS [ppm]	4000	21500	2100
2	Electrical conductivity	10.1	18.8	N/A
3	pH	8.33	10.74	5.5-9.0
Sample 2				
4	TDS [ppm]	7500	22900	2100
5	Electrical conductivity	11.9	22.9	N/A
6	pH	9.30	10.75	5.5-9.0

Energy and exergy analysis of DSSS system

Details of the average full-day thermal efficiency of the DSSS system for the two different test situations shown in figs. 7 and 8, where calculated using eq (2). The results showed the respective average full-day efficiencies of the two units were 65%, 60%, and 58%, respectively, (preheated inlet temperature). It should be emphasized that efficiency depends mostly on the daily yield of freshwater collected and sun radiation. The highest freshwater yield was attained, resulting in the highest full-day efficiency, thanks to increased inlet temperatures and flow rates. Figure 8 depicts the mass-flow rate of 3 Lpm, 2 Lpm, and 1 Lpm with an average daily efficiency of 35% ,33%, and 31%. The increase in energy efficiency is largely the result of the heat transfer coefficient observed at faster air movement. It is also important to note that increased freshwater yield was made possible by a combination of ambient factors, including ambient temperature and wind speed, in addition to a rise in water vapor temperature caused by a higher inlet HTF temperature inside the still chamber. Details of the daily energy and exergy efficiency of the DSSS system under the various test settings is shown in figs. 7 and 8 the highest daily exergy efficiency of 5.5% was found when the inlet temperature was 70 °C. However, it decreased to 3% in the case of a 3 Lpm flow rate with an inlet temperature of room temperature. The bars in blue line indicate the energy efficiency with respect to temperature and mass-flow rate, it increases with the temperature and decreases with mass flow rate of the system. An addition of the air heater increased the SS energy efficiency as well as its overall efficiency. The exergy efficiency at 60 °C and 50 °C was seen as is 5.1% and 4.6%, respectively. In the case of ambient temperature as the inlet and mass-flow rates of 2 Lpm and 1 Lpm, it was seen as be 2.5% and 1.8%. The results indicated the ability to get energy efficiency through use of hot air as input.

Economic analysis

The determination of the primary annual charge (PAC) of the SS was carried out through the utilization of eq. (1), while the capital recovery aspect (CRA) of the SS was ascertained through the application of eq. (2). The initial YSV of the SS was ascertained through the utilization of eq. (2):

$$PAC = C(CRA) \tag{1}$$

$$CRA = i\frac{(1+i)^1}{-1+(1+i)^1} \tag{2}$$

Equation (3) are utilized to calculate the salvage cost and sinking fund aspect, denoted as SC and SFA, respectively, while C represents the SS capital cost and I and l represent its interest rate and life, respectively:

$$SFA = \frac{i}{-1+(1+i)^1} \tag{3}$$

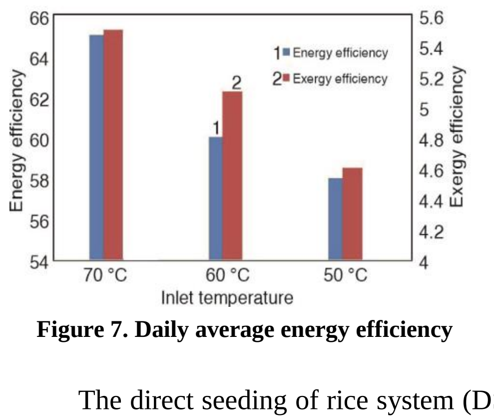

Figure 7. Daily average energy efficiency

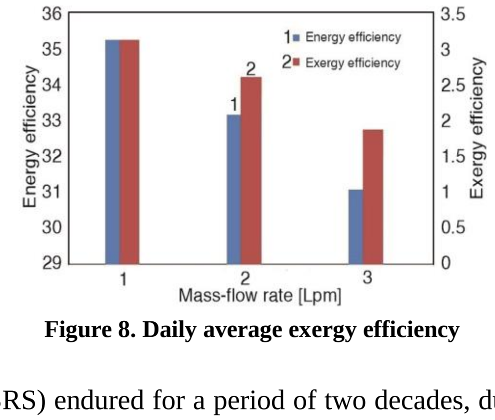

Figure 8. Daily average exergy efficiency

The direct seeding of rice system (DSRS) endured for a period of two decades, during which India's mean annual insolation rate was recorded at 85%, while its banking sector's interest rate averaged at 8%. (experimental site). The total cost of the DSSS system for water was found to be 42 USD per m^2. The cost of freshwater was recorded as 0.011 $ per L, while the still productive rate was found to be 4.84 L per m^2 per day. The implementation of solar photovoltaic technology resulted in a 14.70% rise in the cost of water per litre, equivalent to 0.015 $ per L, and a 69% enhancement in yield productivity. The DSSS system exhibited a remarkable increase in yield productivity due to a marginal rise in the cost of SS when subjected to elevated inlet temperatures. Chennai, the largest city in Tamil Nadu with a high temperature, is facing a severe scarcity of freshwater attributable to inadequate precipitation and excessive exploitation of groundwater for potable purposes in the context of society-based technology. The suggested experimental arrangement aimed at generating freshwater from brackish water sources holds potential for advancing the design of solar desalination systems that are both cost-effective and reliant on RES. In regions where solar energy is available throughout the year, utilizing it for the provision of freshwater to remote and rural communities would be advantageous.

Conclusions

A solar still with a dome-shaped design was developed and fabricated with the aim of enhancing the production of potable water. Solar PV technology was utilised to power the solar still, resulting in an increase in the temperature of the water in the basin. An evaluation was conducted to compare different testing conditions in order to assess the enhancement of freshwater production. Based on the results of the experimental study, several significant conclusions were reached.

- The DSSS was found to produce a maximum freshwater yield of 0.62, 0.59, and 0.5 L per hour at flow rates of 1 Lpm, 2 Lpm, and 3 Lpm, respectively. The incorporation of a photovoltaic panel-powered blower and an air heater has resulted in a noteworthy enhancement in the maximum yield of freshwater. Specifically, the maximum yield has increased to 0.89, 0.80, and 0.744 L per hour for a mass-flow rate of 3 Lpm. The enhanced energy input from the air heater facilitated an increase in the rate of evaporation, thereby enabling the attainment of optimal yield.
- The energy efficiency of direct steam generation solar (DSGS) was observed to be 35%, 33%, and 31% for flow rates of 1 Lpm, 2 Lpm, and 3 Lpm, respectively. However, at higher inlet temperatures of HTF such as 70 °C, 60 °C, and 50 °C, the energy efficiency of DSSS increased significantly to 65%, 60%, and 58%, respectively.
- The study determined that at flow rates of 1 Lpm, 2 Lpm, and 3 Lpm, the exergy for the entire day was 3%, 2.5%, and 1.8%, respectively. Nevertheless, a significant surge was observed, with percentages of 5.5, 5.1, and 4.6, respectively, in the event of heightened temperatures at the inlet of the HTF at 70 °C, 60 °C, and 50 °C.
- The production cost of one litre of water without any rise in the inlet temperature was found to be 0.011 $ per L, whereas the cost of producing one litre of water with an increase in the inlet temperature was 0.015 $ per L. According to the findings of the economic analysis, freshwater production has been identified as the most cost-effective option in both scenarios.

A dome-shaped solar still was designed and constructed with the objective of improving the generation of drinkable water. The SS was powered by solar PV technology, which led to a rise in the temperature of the water contained in the basin. A comparative analysis was performed to evaluate diverse testing scenarios with the aim of assessing the augmentation of freshwater generation. Several significant conclusions were drawn based on the findings of the experimental study.

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