

ASSESSING FLOATING SOLAR POTENTIAL IN SRI LANKA USING A HYBRID SARIMA-LSTM FORECASTING APPROACH

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Sri Lanka's energy sector is significantly dependent on fossil fuels. Despite considerable solar irradiance potential, solar energy currently accounts for only 5% of the country's electricity production. Large-scale solar expansion is constrained by land-use conflicts. Floating Solar Photovoltaics (FPV), deployed on reservoir surfaces, offer a sustainable alternative by utilising underutilised water bodies without competing for land. This study aimed to forecast the solar energy generation potential across 18 major reservoirs in Sri Lanka. The analysis used monthly aggregates of daily meteorological and solar irradiance data from January 2010 to December 2022. Solar energy generation was estimated based on a 1 m² panel area after adjusting for environmental and efficiency factors. For each site, the dataset was divided into training (80%) and testing (20%) subsets. A Seasonal Auto-Regressive Integrated Moving Average (SARIMA) model was first applied to capture the linear and seasonal patterns of the time series. The residuals from SARIMA were then used to train Long Short-Term Memory (LSTM) models to capture non-linear dependencies. The final hybrid forecast for the 32-month test period was obtained by combining the SARIMA forecasts with the LSTM-predicted residuals. Model performance was evaluated using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), the coefficient of determination (R^2), and Mean Absolute Percentage Error (MAPE). Results showed that the average monthly solar output ranged between 30 – 120 kW h m⁻², with February to April being the most productive period. The hybrid model performed strongly, achieving MAPE values under 3.5% at all sites, and mostly below 2%, highlighting its high accuracy and reliability in predicting solar energy potential across diverse locations.

Keywords: Floating solar photovoltaics, Long short-term memory, Renewable energy, Seasonal auto-regressive integrated moving average