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Economics of wind energy utilisation for water pumping and CO₂ mitigation potential in Niger Delta, Nigeria

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Abstract

The wind characteristics of six locations in Niger Delta, Nigeria, and the economics of the application of wind energy for water pumping and possible avoidable CO₂ emissions through wind utilisation were examined. The wind data were measured at 10 m height and analysed using the two-parameter Weibull model. Small size wind turbines were accessed with Goulds 45J03 water pump series. The average power density, average energy density and annual energy across locations ranged between

$$6.28 \leq \text{APD} \leq 102.90 \text{ W/m}^2,$$

$4.49 \leq \text{AED} \leq 82.96$

kWh/m² and

$422 \leq \text{AE} \leq 747$

kWh/m²/year, respectively. Bergey Excel-10 kW turbine had the lowest cost of energy and water pumping cost of

$0.022 \leq \text{COE} \leq 0.151$

\$/kWh and

$0.074 \leq \text{WPC} \leq 0.403$

\$/m³, respectively. The annual capacity of water yield varies from 21,847 to 120,206 m³/year on a total dynamic head of 50 m. Furthermore, the annual diesel saved across the locations ranged from 1605 to 8696 l/year (17.47 to 94.67 GJ/year), while the annual averaged CO₂ saved was between 4.32 and 22.93 tons/year.

KEYWORDS: [Wind energy](#), [CO₂ emissions](#), [water pumping](#), [wind turbine](#)

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