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Summary. Comparison of the values of the digital coordinates of motor oils with the coordinates of the ASTM D 1500 scale (Figure 9) shows good agreement in color tone H for all oils, and for oil with a score of 3, a deviation in saturation S and brightness B. Such a deviation may be associated either with an inaccurate assessment of points during visual comparison with the scale, or with incorrect calibration of color filters when using a colorimeter.

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ECONOMIC ANALYSIS OF HYBRID DC BATTERY-SOLAR POWERED RECHARGEABLE IRRIGATION WATER PUMPING DEVICE

ЭКОНОМИЧЕСКИЙ АНАЛИЗ ГИБРИДНОГО УСТРОЙСТВА ДЛЯ ОРОШЕНИЯ ПИТАНИЕМ ОТ АККУМУЛЯТОРНОЙ БАТАРЕИ И СОЛНЕЧНОЙ ЭНЕРГИИ

Abstract. In agriculture both mechanical and electrical power is essential input for agriculture in order to produce crops. It runs many pieces of agricultural machines and equipment using electricity or fossil fuels. These days, a variety of agricultural technologies are available to increase crop yield at a lower cost and energy consumption. The key component of any crop-raising technique is water pumping for irrigation, and farmers must rely on grid power or fossil fuels to operate their pumps. This research proposes the use of hybrid DC battery-solar powered rechargeable irrigation pumping device and its practical adoption to boost crop production. It was discovered that the financial and environmental advantages of using hybrid pumping device compared to diesel pumps. It was discovered that a 7 HP diesel irrigation pump would have used 660 liters of diesel, releasing 1,716 kg of CO_2 into the environment, to irrigate a piece land of onion. Additionally, it is of financial benefit if the entire amount of carbon dioxide

emissions were turned into carbon credits and offered for sale on global markets. Therefore, it makes financial sense to install a solar-powered water pumping system when irrigating crop by Nigerian small-scale farmers

Keywords: economic, irrigation, solar-powered, water pumping, greenhouse gases

INTRODUCTION

The economy of Nigeria is driven by agriculture. In addition to providing food, it is Nigeria's main employer. Agriculture continues to be the foundation of the country's economy. It significantly boosts the GDP of the nation and creates jobs. Agriculture continues to be the main source of income for almost 70% of its rural families [1]. Nigeria's agriculture achieved substantial output and technological advancements following independence. Increasing agricultural output and enhancing food security were the main goals of previous strategies for the growth of Nigeria's agriculture industry. Nigeria now gets a large portion of its energy from fossil fuels. Thermal power plants (Figure 1) generate about 6964.85 MW [2]. According to [3], 37.4% of the greenhouse gases released into the environment are caused by energy produced by burning fossil fuels. In 2021, Nigeria emitted 334m metric tonnes of carbon dioxide equivalent (CO_2e). Since 1990, their emissions have increased by a compound annual growth rate (CAGR) of 1%. (Figure 2). Fossil fuel combustion raises carbon dioxide emissions, a primary cause of the current climate change catastrophe [4].

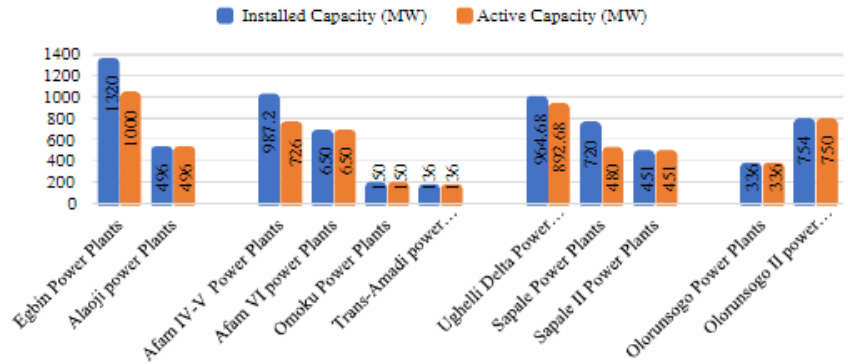

Figure 1 – Thermal Power plant in Nigeria. Source:

Subsequently, government will provide subsidy on setting up of solar power plants on their barren land. Through Agricultural Development Project (ADP) scheme, government should prioritize the fabricated hybrid pumping devices in the effort to double the income of farmers by 2026. Considering the importance of hybrid pumping device, following study was undertaken.

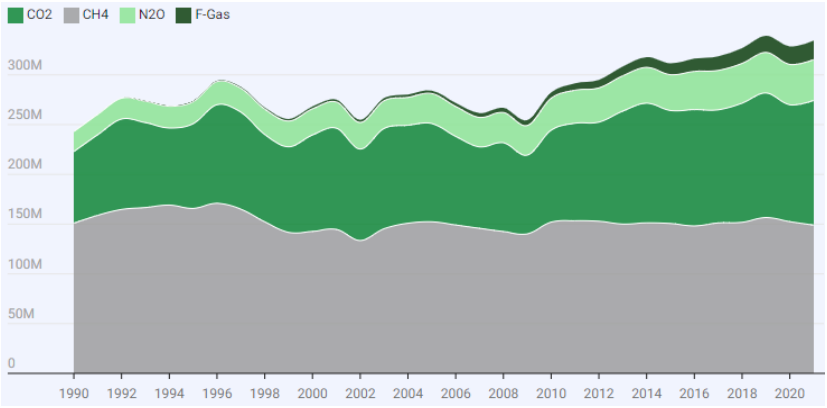

Figure 2 – Greenhouse gases measured in million metric tonnes of carbon dioxide equivalent (CO2e). Data excludes Land-Use Change and Forestry (LUCF)
Chart: Emission Index *Source*: Climate Watch [5]

METHODOLOGY

Study was based on primary data which was collected with the help of survey schedule. Respondents included farmers who were using 7 HP diesel pump for irrigation, but later replaced it with solar irrigation pump. To examine the economic benefits of solar irrigation pumps, the amount spent on diesel fuel used for running diesel pump was calculated. After the adoption of solar irrigation pump, farmer didn't purchase diesel so the expenditure on diesel was saved which was the economic benefit. Environmental benefit realized by adoption of solar irrigation pump was reduction in carbon emissions. To find out the reduction in carbon emissions, first of all diesel saving on irrigation were quantified with the help of following relation: 1 litre diesel = 2.6 kg CO_2 emission [6] 1 kg CO_2 = 0.27 kg carbon [7].

RESULTS AND DISCUSSION

Economic benefits of solar irrigation pumps

In the study area, average area under onion was 0.7 Ha. Diesel consumption for irrigating total area of onion by using 7 HP pump. A 7 HP diesel pump took 11 hours on an average to irrigate one hectare area in the study area. Average rate of diesel consumption of the 7 HP diesel pump was 2.5 litres per hour. Cost of diesel during the study period was estimated to be NGN 1100 per litre.

Total area of onion allocated by sample farmers was estimated to be 0.70 hectares per farm. Total number of irrigations provided by the sample farmers to onion was 12 during the crop period. Fuel consumption by the 7 HP diesel pump to irrigate 0.70 hectares of onion of the sample farmers was estimated to

be 231.00 litres. So, total amount spent on diesel would be equal to NGN 277,200 per growing season of the onion. It was found from the result that if 7 HP diesel irrigation pump was used to irrigate 0.70 hectares of groundnut, and then the total consumption of diesel would be 693 litres per year. This indicates that one farmer had to spend a total of NGN 831,600 to irrigate their crops per season. Since, hybrid DC battery-solar powered rechargeable irrigation water pumping device were used in the study area, so, there was no diesel consumption for the purpose of irrigation. Thus, the savings on diesel consumption was equal to the expenditure on fuel, amounting to NGN 831,600. Also, it was found that 693 litres of diesel were saved during a year by the adoption of hybrid DC battery –solar irrigation pumping device. These findings are also in line [8].

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