 ISSN 2829-4998


# Feasibility of floating solar photovoltaic systems (FSPVs) development in Nigeria: an economic cost appraisal case study

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ARTICLE INFO

**Article history**
Received April 22, 2023
Revised April 24, 2023
Accepted April 30, 2023
Available online May 08, 2023

**Keywords**
Floating solar photovoltaics
Economic cost appraisal
Levelized cost of energy
Feasibility
Nigeria

ABSTRACT

Apart from evading the formidable problem of land acquisition and consumption for solar PV projects in coastal regions, floating solar photovoltaic systems (FSPVs) panels can generate more energy than their counterparts, due to the cooling effect of the water. This study focused on evaluating the economic viability of developing a FSPVs project in Nigeria, using Ikang river, Bakassi as an incident study. The FSPVs was designed using the HOMER software to satisfy full load requirements of 2426.45 kWh/day, while appraising the viability of the FSPVs in incident study. Geographical coordinates, ambient temperature, and global horizontal irradiance of the incident study location were used to select a suitable FSPVs design for the cost appraisal. Lifecycle cost model was further developed to evaluate the proposed FSPVs at different project development phases. These include: predevelopment and consenting (P&C), procurement and acquisition (P&A), installation and commissioning (I&C), operation and maintenance (O&M), and decommissioning and disposal (D&D). The results obtained showed that the net present cost, Levelized cost of energy, and operating cost of the project were 10,350,933.25USD, 0.90USD/kWh, and 179,164.73USD, respectively. Also, the capital expenditure (CAPEX) amassed by 81.53% of the entire project cost, while operating expenditure (OPEX) was 18.47%. For the lifecycle stages; P&C, P&A, I&C, O&M and D&D were obtained to be 12%, 57.9%, 11.6%, 9.96%, and 8% respectively of the project cost. Thus, the incident study location has the potential for FSPVs development and has proven to be economically viable. Nevertheless, established model was suitable in appraising preliminary variations in FSPVs.



## 1. Introduction

The shortage of livable land, rising energy utilization, and environmental repercussions of fossil fuels are nurturing the development of renewable energy projects in the aquatic environment [1]. The oceans obtain 70% of the worldwide primary energy resource (radiation from the sun) [2]. As we know, the world's economy is hugely reliant on fossil fuel carriers and these fossil fuel reserves are limited and expected to run out by the next century [3]. The rising demand for energy globally and the world's economic situation with the use of available resources rationally have propelled the transition to alternative energy [4], [5]. Its goal is for sustainable development and helping approaches in the search for optimally new strategies to utilize the technologies available [6]. Among the different types of renewable energy, photovoltaic (PV) solar energy is proving reliable. Although, it has not reached adequate development, efforts are being made in PV technology research towards lower industrialized costs and higher efficiencies [7]. According to [8], the installation of these technologies was formerly limited to land, but land being a quality commodity and the huge necessity for it, is forcing these technologies to go offshore. This shift has presented benefits and drawbacks. For solar; the benefits include less obstacles to obstruct sunlight, less dust effect, elevated energy efficiency due to lower temperature beneath the panels, etc. [9]. On the other hand, for wind, it is the advanced and more dependable wind speeds, consequential in higher power generation [10]. The drawbacks include; difficulties associated with moving, installation, mass departure of power, threats like cyclones, sea waves, storms, high tides and tsunami, increased decay of the metallic structure, increased maintenance, the consequence on fishing, and other transportation activities depending on the selected site [11].

[7] stated that the floating solar power plants also has its challenges besides the fundamental electrical design. The study on the maximum power points, cables design, and the design against the ocean or aquatic ecological state should be intentional. Even the structure has to conquer the sturdy wind or cyclone. The connection of cables from solar panels structure to the shore also has to defeat environmental impact assessment [12]. Fig. 1 shows the average installed costs for solar photovoltaic from 2010 – 2020.

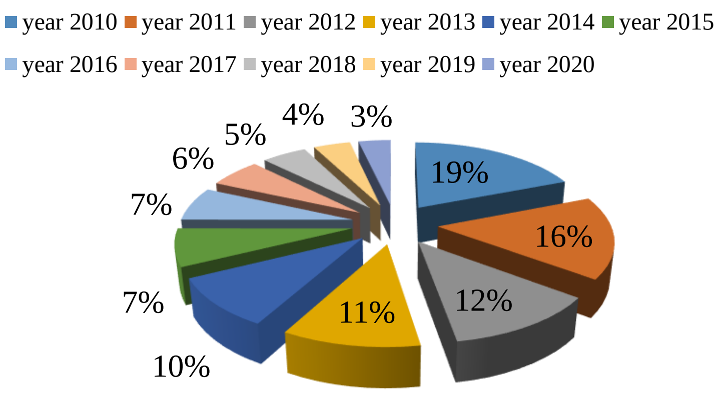


**Fig. 1.** Global cost of installed PV per kilowatt [13]

Offshore solar farms do not compete with other land uses and possibly helps reduce water evaporation rates in specifically tropical climate due to its surface coverage, protecting the water from heat and wind [14]. This is vital when people's livelihood is dependent on land uses and water resources like the southern region in Nigeria. This region has excellent potential for FSPVs on 7,158 reservoirs currently used for flood control, energy storage, hydropower generation, daily water usage, fishing, and irrigation [15]. Few components make up the FSPVs, this includes; mooring system [14], floats [11], pontoon [16], crystalline solar PV modules, and connectors and cables [8]. Offshore solar farms present a contributing solution to the standing effects of land based solar farms. These effects are majorly dust effect, and increased temperature underneath the panels [17]. It is evident that extensive studies have been carried out to analyze the techno-economic feasibility of land based solar PVs for various on-grid and off-grid applications. However, offshore FSPVs could be a better alternative compared to land based [18]. On this backdrop, this study provides an approach to evaluate the economic cost viability of developing a FSPVs farm project in an incident study location situated in Nigeria, which not yet been extensively studied.

## 2. Method

The economic viability of developing the FSPVs project was evaluated using the HOMER software. The flowchart that summarizes the methodology is depicted in Fig. 2. The HOMER software integrates multiple energy resources to design and optimize hybrid energy systems [19], [20]. The software was used to examine the life cycle cost ranking, and its configuration in terms of its cost effectiveness.

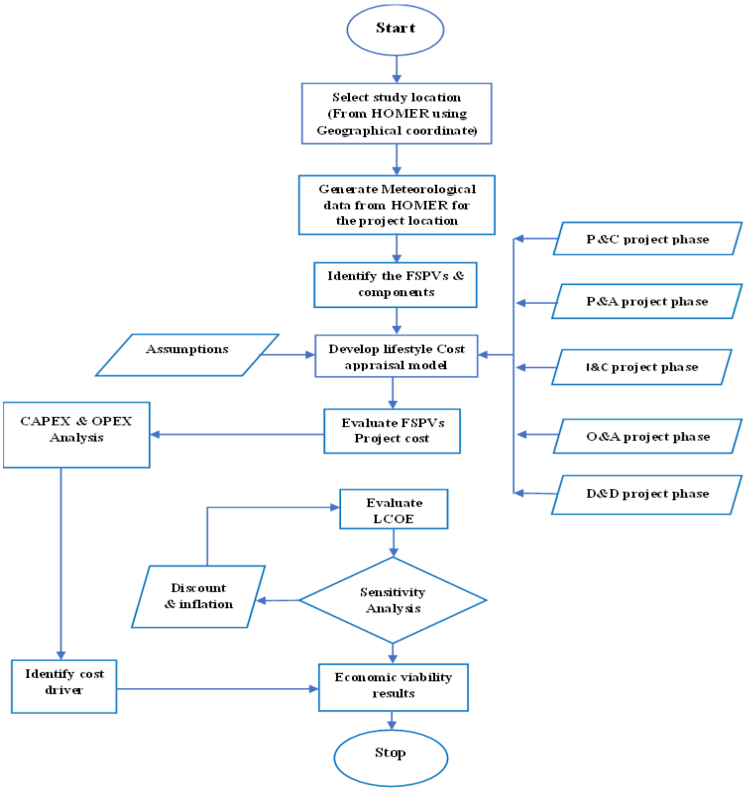


**Fig. 2.** Methodology flowchart

The FSPVs was selected after the temperature, global solar horizontal irradiance (GHI) data, and the load of the region were obtained from the HOMER software. Firstly, the coordinates of the region were inputted to obtain the load, temperature, and solar GHI. These data were further used to select the solar PV panel based on its capacity to service the load of the study region. The HOMER software further provided the technical specifications of the FSPV from its directory to run the cost appraisal simulation. As a result, a detailed cost summary and breakdown of every component of the designed FSPVs, and the electricity produced were obtained.

## 2.1. Floating photovoltaic system

Mounting FSPVs over water bodies is innovative [21]. The combination of PV plant technology and floating technology results in electricity generation [22]. The proposed floating PV plant to be developed is made up of a pontoon or independent floats, a mooring system, and solar panels with cables (see Fig. 3). These components play a vital role in checking the viability of having a floating solar farm in Nigeria. As long as the anchoring and mooring system is permanently structured underwater, the installation process for FSPVs is frequently simpler than land solar PVs [23]. The installation does not need heavy equipment, and the system is often erected on land before being carried to a body of water and pulled to the site [19], [24].

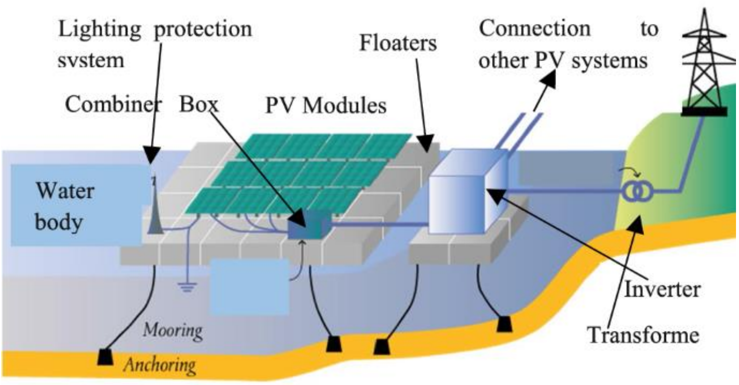


**Fig. 3.** Schematic of a floating solar PV [25]

The PV conversion efficiency under operating settings is the most essential metric used to examine the performance evaluation of the FSPVs [12], [7]. Thus, the conversion efficiency of a PV module is determined by the ratio between the generated electrical power and the incident solar radiation intensity as expressed in Eqn. (1).

$$\eta_{el} = \frac{P_{max}}{SXA_{pv}} x\ 100\% \quad (1)$$

Where $\eta_{el}$, $P_{max}$, $S$, and $A_{pv}$ are the Electrical efficiency (%), Power generated by PV module (W), Solar radiation intensity of the PV module (W/m2), and PV module surface exposed to the solar radiation intensity (m2), respectively.

Meteorological data of the incident study location which include geographical coordinates, ambient temperature, and global horizontal irradiance (GHI) as obtained from the HOMER software were used to select a suitable FSPVs design for the cost appraisal. This data is also required in the FSPVs and substation infrastructural development [26]. Furthermore, the lifespan of the FSPVs project was assumed to be at 25-30 years considering the inflation rate of Nigeria at 8% [14],[23]. Using the fisher expression, the annual interest rate is determined at 3.7% [23].

## 2.2. Lifecycle cost appraisal model

Lifecycle cost appraisal model was further developed to evaluate the proposed FSPVs at different project development phases. The phases include: predevelopment and consenting (P&C), procurement and acquisition (P&A), installation and commissioning (I&C), operation and maintenance (O&M), and decommissioning and disposal (D&D). Adapting the approach of [27]–[29], a cost breakdown used the evaluate the levelized cost of energy (LCOE) was implemented. The FSPVs project cost is expressed in Eqn. (2).

$$C_{FSPVs} = \sum C_{P\&C} C_{P\&A} C_{I\&C} C_{O\&M} C_{D\&D} \quad (2)$$

### 2.2.1. Pre-development and Consenting

Before the development process of the FSPVs, systematic feasibility studies were carried out to access the potential for an FSPVs in the chosen location. Factors such as solar resource availability, cost of project, and the potential for grid connection were also considered. Getting the necessary permits and approvals from government, relevant authorities, and community liaisons were also factored in. The pre-development and consenting cost were evaluated using Eqn. (3).

$$C_{P\&C} = \sum C_{mp} C_{la} C_{sv} C_{eng} C_{cg} \quad (3)$$

Where; $C_{mp}$, $C_{la}$, $C_{sv}$, $C_{eng}$, and $C_{cg}$are the cost of managing the project, legal authorization process cost, survey cost, cost of engineering activities, and contingencies cost respectively. $C_{mp}$is assumed to be 5% of total capital expenditure [29].

### 2.2.2. Procurement and Acquisition

Procurement cost is one aspect that cannot be overlooked. This includes designing and engineering, procurement of the PV panels and other components, and its electrical infrastructure. The cost of procurement and acquisition was evaluated using Eqn. (4).

$$C_{P\&A} = \sum C_{mps} C_{ft} C_{ptn} C_{spv} C_{cc}\, C_{as} \quad (4)$$

Where; $C_{mps}$, $C_{ft}$, $C_{ptn}$, $C_{spv}$, $C_{cc}$, and $C_{as}$ are cost of procuring mooring system, cost of procuring floats, cost of procuring pontoon, cost of procuring solar PV modules, cost of procuring connectors and cables, and cost of anchoring system respectively.

### 2.2.3. Installation and commissioning

For the globally weighted-average, the installed costs for solar projects in 2019 was 18% below the average of 2018, and 79% below the 2010 weighted average [8]. Installed costs reduction are caused by varying factors; reduced labour costs, enhanced module efficiency, and improved manufacturing processes. The developers' experience and supply chain structure has led to an increasing number of marketed PV systems attaining competitive cost structures and declining globally weighted average for total installed costs [30]. As though the solar PV system keeps advancing, the installed cost differences increase. There is a need to understand the difference in specific cost of solar PV system components in the individual markets, as this remains pivotal to unlocking the reduction potential. As the market continues to grow, it is believed that some of the remaining cost variance will continue to decline. The installation cost of a floating SPV is much more than that of a land based solar PV because of its anchoring systems and mooring, and the cabling across the system [8], [30]. However, Eqn. (5) was used to evaluate the installation and commissioning cost.

$$IC = IRF \frac{\Gamma}{8760.C_f.\sum_{t=1}^{T} x_t.y^t} \tag{5}$$

Where; $C_f$, $T$, $x_t$, and $\Gamma$ represents the annual capacity factor, lifetime of the project, annual degradation factor, and discount factor respectively. Also, $IRF$ which is the Incentive-based reduction factor is given in Eqn. (6) as;

$$IRF = \sum C_{CW} C_{ME} C_{EE} C_{ICFC} C_{OWN} \tag{6}$$

Where; $C_{CW}$, $C_{ME}$, $C_{EE}$, $C_{ICFC}$, and $C_{OWN}$ are the civil works cost, mechanical equipment cost, electrical equipment cost, indirect cost, fees and contingency, and owner cost respectively.

### 2.2.4. Operation and maintenance

The operation and maintenance (O&M) cost of the utility high scale solar PV has declined over the years in certain markets where the capital cost has gone down more than the (O&M) cost [14]. O&M enhances the reliability and performance of the FSPVs [11]. The associated cost is expressed in Eqn. (7).

$$OC = \left(DMS\,.y^t + OR\,.y^{\frac{t}{2}}\right).IC \tag{7}$$

Where; $DMS$, and $OR$ are the decommissioning, and occasional replacement respectively. Thus, the total operational and maintenance cost ($T_{OM}$) was evaluated using Eqn. (8).

$$T_{OM} = \sum C_{EQM} C_S\, C_{LSM} C_{ASM} C_{CC} C_{OEM} C_{OLC} C_{OI} \tag{8}$$

Where; $C_{EQM}$, $C_{CC}$, $C_{ASM}$, $C_{OEM}$, $C_{OI}$, $C_{OLC}$, $C_{LSM}$, and $C_S$ are the equipment maintenance cost, connection cost, anchor system maintenance cost, operative environmental management cost, operational insurance cost, operational law charges, line and substation maintenance cost, and salaries respectively.

### 2.2.5. Decommissioning and disposal

Solar PV systems are long lasting and durable, if the right conditions are met [31]. Decommissioning and disposing the FSPVs is the reverse of installing it. The time to pull down the system varies with the size of the project. The process of decommissioning a large-scale solar PV system with probably a 30-year lifespan would be pricey [31]–[34]. Excerpts from [29] was used to develop eqn. (9) and used to evaluate the cost of decommissioning and disposal.

$$C_{D\&D} = \sum C_{dm} C_{wm}\, C_{cs} C_s \tag{9}$$

Where; $C_{dm}$, $C_{wm}$, $C_{cs}$, and $C_s$ are the cost of decommissioning, cost of waste management, cost of clearing the water bodies per unit area, and cost of supervision respectively.

### 2.2.6. Levelized cost on energy (LCOE)

The LCOE, evaluated is expressed in Eqn. (10) and (11) as;

$$LCOE = \frac{sum\ of discounted\ costs\ over\ lifetime}{sum\ of\ discounted\ energy\ produced\ over\ lifetime} \tag{10}$$

$$LCOE = \frac{\sum_{t=0}^{n} \frac{I_t + M_t + F_t}{1+(r)^t}}{\sum_{t=0}^{n} \frac{E_t}{(1+r)^t}} \tag{11}$$

Where; $I_t$, $M_t$, $F_t$, $E_t$, $R$, and $T$ are the investment expenditure in a year (t), operation and maintenance expenditures in a year (t), fuel expenditures in a year (t), energy produced in a year (t), discount rate (%), and expected lifetime of the system respectively [30], [34].

### 2.3. Incident study

The incident study area for this research was narrowed down to the Niger delta region of Nigeria, because of the huge volume of water that surrounds the area, the solar irradiance, and atmospheric temperature. The global solar horizontal irradiance data of the study location is depicted in Fig. 4, with its scaled annual average at 4.28 kWh/m2/day.

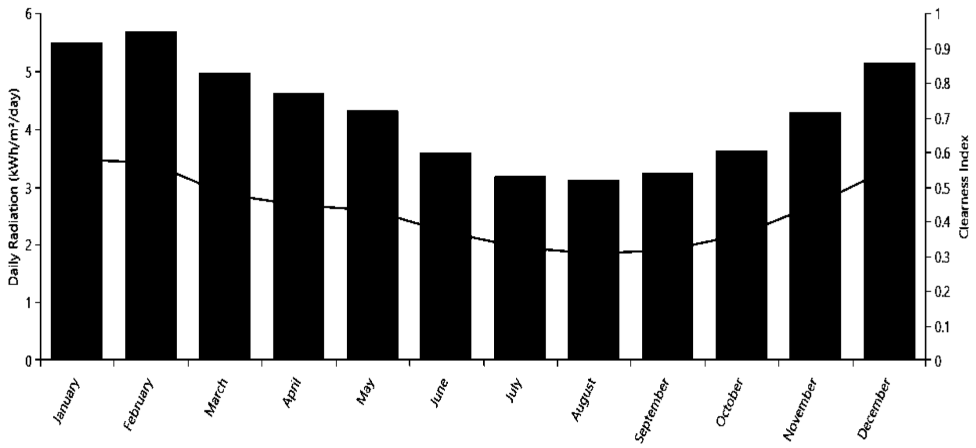


**Fig. 4.** Global daily solar horizontal irradiance for Bakassi [20]

Also, Fig. 5 depicts the temperature resource of the case study location with a scaled annual average of 24.67°C.

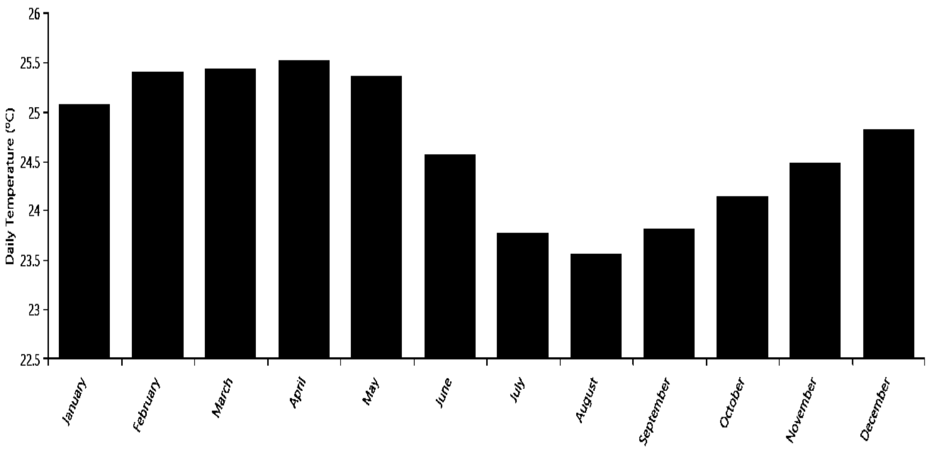


**Fig. 5.** Temperature resource for Bakassi [20]

Nigeria has a coastline of 853 kilometers with 450 kilometers inland waterways, and a 200 nautical miles sovereign right to exclusive economic zone [35], [15]. The coordinates from the HOMER software were used to select the study location. This study was carried out based on data gotten from the National Renewable Energy Laboratory (NREL) directory on the HOMER software for the potential area with renewable energy resources. Also, the data of other parameters that affects the viability of developing an offshore solar farm in that region were obtained. As depicted in Fig. 6, the selected area is the Ikang river in Bakassi that is located in Cross River State, the Niger-Delta region of Nigeria. Ikang River lies between 4˚ 48’ 0” North and 8˚ 32’ 0” East on the latitude and longitude of the equator [20].

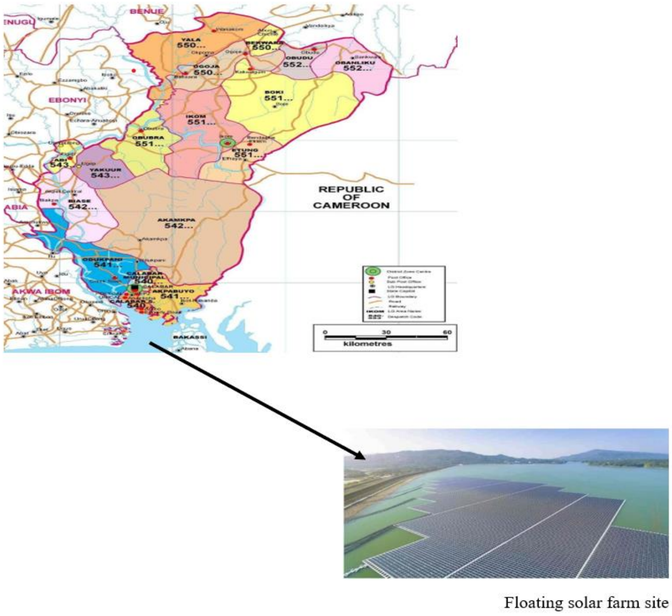


**Fig. 6.** Incident study area for developing the floating solar farm site

## 3. Results and Discussion

Table 1 presents the technical specifications of the solar PV arrays selected and the installation requirements.

**Table 1.** FSPV parameters from HOMER

| Properties (units) | Configuration |
|---|---|
| Name | Ingeteam (1164kVa) with generic PV |
| Panel type | Flat plate |
| Rated capacity (kW) | 1164.1 |
| Temperature coefficient | -0.4100 |
| Operating temperature (℃) | 45.00 |
| Efficiency (%) | 17.30 |
| Nominal capacity (kWh) | 5309 |
| Installed capacity (kWh/year) | 2,179,179 |
| Autonomy (hours) | 42.0 |
| Usable nominal capacity (kWh) | 4,247 |
| Rectifier mean output (kW) | 30.2 |
| Inverter mean output (kW) | 25.8 |
| Distance to onshore grid connection (km) | 12 (assumed) |
| Distance to offshore grid connection (km) | 50 (assumed) |
| Operational life (years) | 25 |
| PV penetration (%) | 246 |

### 3.1. Result of lifecycle cost appraisal

Results of the lifecycle cost appraisal from the model developed to evaluate the proposed FSPVs at different project development phases is presented. The phases include: predevelopment and consenting (P&C), procurement and acquisition (P&A), installation and commissioning (I&C), operation and maintenance (O&M), and decommissioning and disposal (D&D). The total cost for installing a floating solar farm at the incident location in Nigeria was evaluated to be USD 10,350,933.02.

Fig. 7 shows the cost distribution of the predevelopment and consenting phase of the FSPVs project lifecycle. Predevelopment and consenting are the first phase for the commencement of the project. Its importance cannot be overlooked, as it gives insights to the project conception. For predevelopment and consenting cycle phase, the results show that the cost of managing the project is 5% of the total capital cost which is USD 517,546.65. This also accounts for 41.66% of the cost of predevelopment and consenting. However, other costs accounts for 58.34%; these include 10% (USD 124,211.20) legal authorization process, 10.34% (USD 128,434.38) survey cost, 30% (USD 372,633.59) cost of engineering activities, and 8% (USD 99, 368.96) contingencies. The cost breakdown shows the feasibility of successfully undergoing these processes within the project cycle.

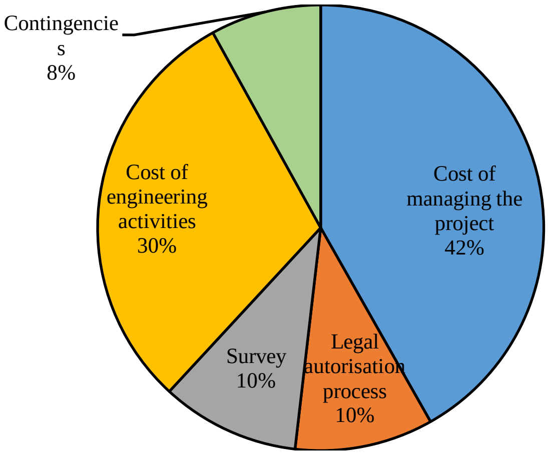


**Fig. 7.** Cost distribution for predevelopment and consenting

Fig. 8 depicts the cost distribution for procurement and acquisition phase of the project cycle. The total cost of procurement and acquisition amounted to USD 5,993,190.22. The solar PV module account for 60.05% (USD 3,599,509.96) of the procurement and acquisition cycle. Others include the mooring system, the pontoon, the floats, the connectors and cables, and the anchoring system, accounting for 8.2% (USD 491,441.60), 7.6% (USD 455,481.41), 7.2% (USD 431,509.70), 7.8% (USD 467,468.83), and 9% (USD 539,387.11) respectively.

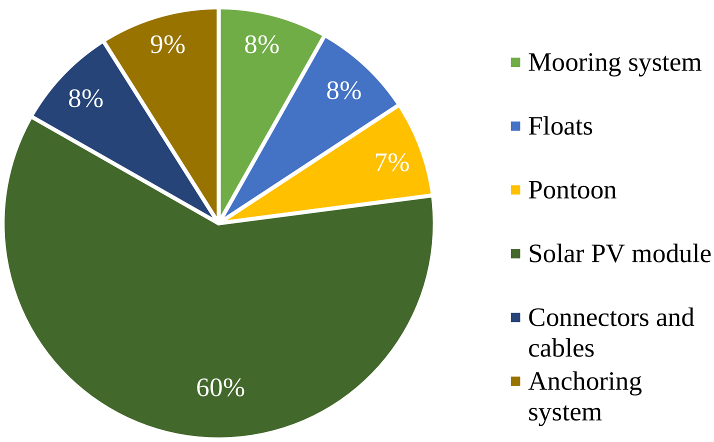


**Fig. 8.** Cost distribution for procurement and acquisition

Fig. 9 depicts the cost distribution of installation and commissioning phase of the FSPVs project cycle. The cost of installation and commissioning amounts to USD 1,204,107.26. The breakdown includes 15% (USD 180,616.09) civil works, 33% (USD 397,355.39) mechanical equipment, 25% (USD 301,026.81) electrical equipment. Also, indirect cost, fees, and contingency, and owners cost amounts to 15% (USD 180,616.09), and 12% (USD 178,120.70) respectively. The required equipment (mechanical and electrical) for the installation process takes a huge chunk of the cost in this project cycle.

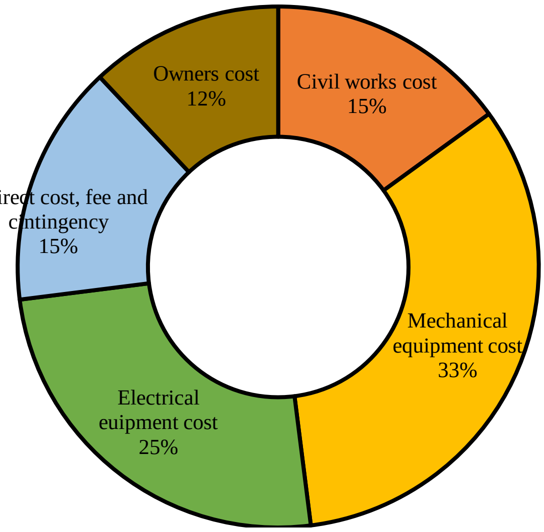


**Fig. 9.** Cost distribution for installation and commissioning

Fig. 10 depicts the cost distribution for operation and maintenance phase of the FSPVs project cycle. The cost of operation and maintenance was evaluated to be USD 1,031,562.11. The cost breakdown includes, 14% (USD 144,418.68) equipment maintenance cost, 12% (123,787.44) connection cost, 12.5% (USD 128,945.26) anchor system maintenance cost, 9.5% (USD 97,998.40) operative environmental maintenance cost, 14% (USD 144,418.68) operational insurance, 9% (92,840.58) operational law charges, 12% (USD 123,787.44) lines and substation maintenance cost, and 16% salaries.

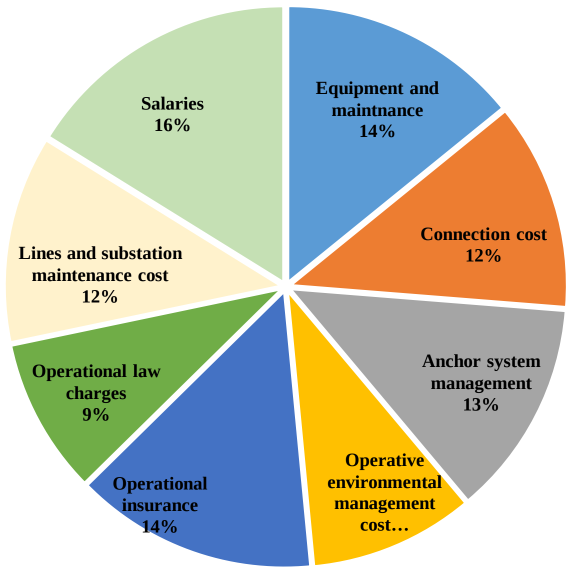


**Fig. 10.** Cost distribution for operation and maintenance

Fig. 11 presents the cost distribution for decommissioning and disposal phase of the FSPVs project cycle. Decommissioning and disposal was estimated to be USD 828,074.54. The cost breakdown includes, 10% (USD 82,807.45) decommissioning the PV panels cost, 6% (USD 49,684.47) racks dismantling cost, 8% (USD 66,245.96) electrical equipment unmounting cost, 10% (USD 82,807.45) cables recovery, 12.6% (USD 104,337.39) anchor systems recovery cost, 12.4% (USD 102,681.23) mooring system decommissioning cost, 12.8% (USD 105,993.54) pontoon decommissioning cost, 12.3% (USD 101,853.16) floats decommissioning cost, and 15% (USD 124,211.18) disposal.

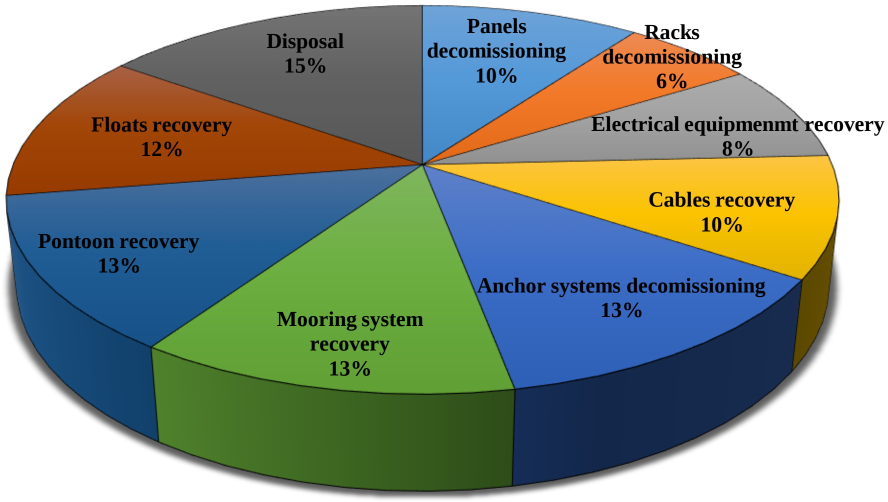


**Fig. 11.** Cost distribution for decommissioning and disposal

Table 2 and Fig. 12 presents the cost breakdown of all project phases in developing the floating solar farm (FSPVs). However, the net present cost, LCOE, and operating cost of the entire project were evaluated to be USD 10,350,933.25 (NGN 4,733,868,730.94), 0.90 USD/kWh (NGN 413.81/kWh), and 179,164.73 USD (NGN 81,938,710.13) respectively. The conversion factor (USD 1.0 to NGN 459.81) was based on Central Bank of Nigeria's conversion rate on 25th January, 2023 at 11:43 am.

**Table 2.** Total project cost distribution

| Development stages | Cost (USD) | Percentage (%) |
|---|---|---|
| P & C | 1,239,411.59 | 12 |
| P & A | 5,980,160.81 | 58 |
| I & C | 1,201,489.49 | 12 |
| O & M | 1,029,319.46 | 10 |
| D & D | 826,274.28 | 8 |
| Total | 10,328,429.94 | 100 |

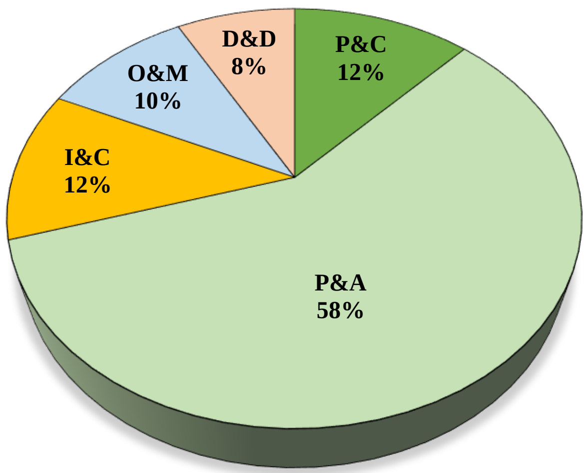


**Fig. 12.** Cost distribution of the FSPVs project development phases

## 3.2. CAPEX and OPEX analysis

The capital expenditure (CAPEX) of the project includes the predevelopment and consenting (P&C), procurement and acquisition (P&A), and installation and commissioning (I&C) project phases, with main drivers cost of USD 4,742,052.19. As the project's main drivers, the installation, support systems, predevelopment and project management, contingencies, indirect cost, fees, and electrical equipment accounted for 15%, 22%, 41%, 2%, 4%, and 16%, respectively; totaling 81.53% of the entire project. However, comparing the expenses of acquiring a floating solar farm in Nigeria with other countries at daily energy usage of 7.23 kWh, the cost was estimated to be 6.32% higher. Fig. 13 depicts the detailed CAPEX cost distribution.

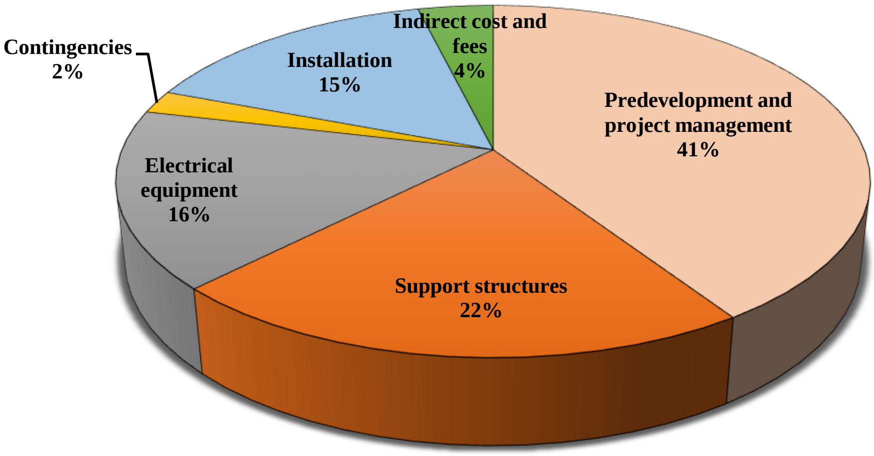


**Fig. 13.** Detailed cost distribution of CAPEX

On the other hand, cost of decommissioning and disposal (D&D) phase was not part of either OPEX or CAPEX, because it occurs after the FSPVs project life of 25 years. Fig. 14 displays the detailed cost distribution of the OPEX. The OPEX of this project was estimated at USD 768,978.61. In Nigeria, the yearly OPEX is expected to cost USD 246.875/kW/year [29]. The costs associated with maintenance were the primary cost drivers of OPEX. However, cost of port, insurance, transmission, and other costs accounted for 13%, 19%, 32%, and 36%, respectively.

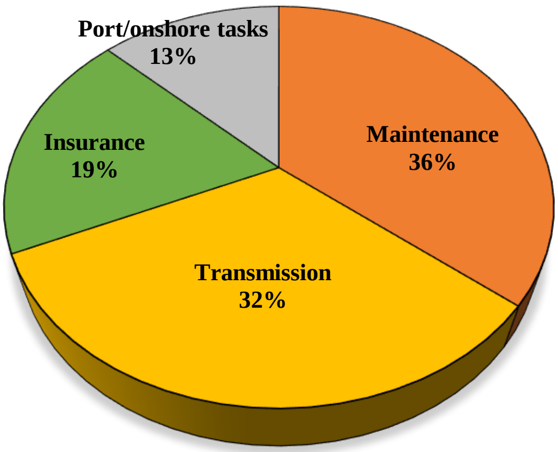


**Fig. 14.** Detailed cost distribution for OPEX

### 3.3. Sensitivity analysis

Sensitivity analysis was further carried out to determine the effect of various factors on the LCOE of the entire project. The factors considered were discount and inflation rates respectively. Results obtained from this analysis using HOMER software showed that as the discount rate increased, the LCOE varied whilst the annual capacity shortage remained constant at 12%. This is demonstrated in

Fig. 15. Furthermore, the percentage range for inflation rate was varied from 1% to 7%. Fig. 16 depicts the reduction in LCOE as inflation rate increases.

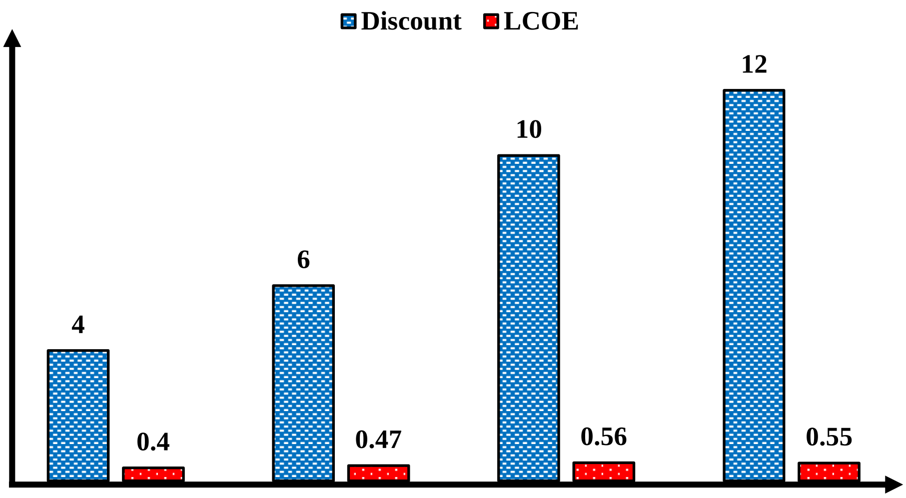


**Fig. 15.** Sensitivity analysis on discount and LCOE

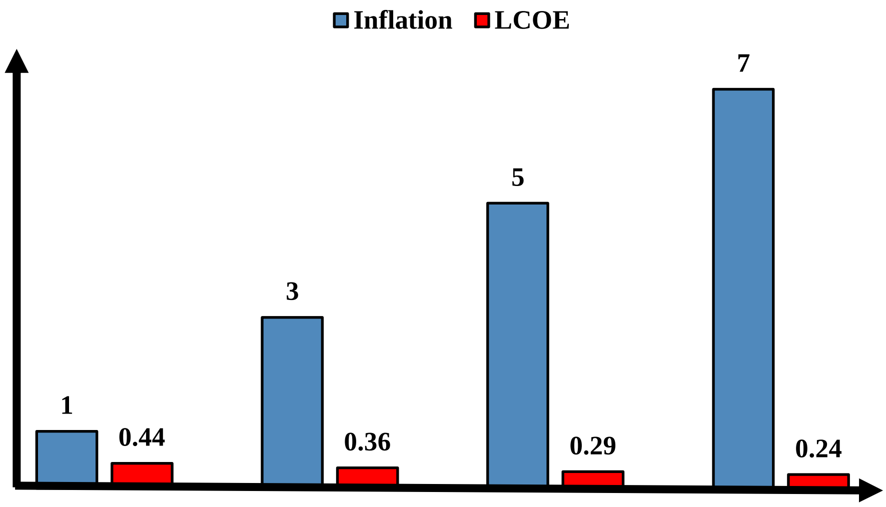


**Fig. 16.** Sensitivity analysis on inflation and LCOE

### 3.4. Potential positive environmental impact of the FSPV

FSPVs technology is an emerging clean energy technology that plays a vital role in decarbonization of the global energy sector. Based on the obtained meteorological data, nautical miles, inland water ways, and small land area in the studied location, developing this FSPVs project will not just have positive techno-economic impacts, but also socio-environmental impacts. Some of which includes; evading the formidable problem of land acquisition and consumption, improving water security by reducing water evaporation (since the FSPVs panels covers the water bodies), improved PV performance due to cooling effect of water, and job creation potential. The solar panel could also serve as shelter to aquatic lives and avoid algal bloom, leading to improved aquatic ecosystem. This also improves the dominant means of livelihood in Bakassi being fishing.

## 4. Conclusion

The scarcity of open lands, along with rising land costs, has resulted in the recent introduction of floating solar photovoltaic systems for energy generation. This study examined the economic cost feasibility of developing this project in Nigeria, using Ikang River in Bakassi as an incident study. A lifecycle cost appraisal model was developed, and five project development phases were examined with this model. CAPEX and OPEX analysis were also carried out to understand the cost drivers of the proposed project. The CAPEX of the FSPVs project includes the P&C, P&A, and I&C project phases, with key drivers' cost of USD 4,742,052.19. However, the OPEX of this project was estimated at USD 768,978.61. Sensitivity analysis was carried out using the HOMER software and displayed effect of inflation and discount rate variations on LCOE. Net present cost of the project, LCOE, and operating cost, were obtained to be USD 10,350,933.25, USD 0.90/kWh (NGN 413.81/kWh), and USD 179,164.73 (NGN 81,938,710.13) respectively. Furthermore, installation, support systems, predevelopment and project management, contingencies, indirect cost, and electrical equipment were the key drivers of the project. Results obtained shows that developing a floating solar farm in Nigeria is technically possible, economically viable, and worth investing.

## Acknowledgment

Special thanks to the clean fuels, energy, and environmental research lab in the Department of Mechanical Engineering, University of Cross River State, Nigeria.

## Declarations

**Author contribution.** All authors contributed equally to the main contributor to this paper. All authors read and approved the final paper.

**Funding statement.** None of the authors have received any funding or grants from any institution or funding body for the research.

**Conflict of interest.** The authors declare no conflict of interest.

**Additional information.** No additional information is available for this paper.

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