International Journal of Basic and Applied Sciences, 14 (8) (2025) 314-321

International Journal of Basic and Applied Sciences

Website: www.sciencepubco.com/index.php/IJBAS
https://doi.org/10.14419/3k51cs13
Research paper

Developing a Framework for Public-Private Partnerships in Accelerating Clean Energy Transition in Africa

Emmanuel Chijioke Nwadike [1] *, Charles Odinakachi Njoku [1], Kelechi Enyinna Ugwu [1], Edward Uche Omeire [1], Cletus Ikechukwu Anah [1], Christy Chidiebere Nwachi [1], Benedict Nkemdirim Igbokwe [1], Gregory Chimere Enyinna [1], Chidi Christian Onyeanwu [1], Chizube Ihunna Nwadike [2], Chinenye Ehikem Obialor [3], Pauline Chinasa Nwizu [3], Blessing Chibuzo Nwokeke [4], Kingsley Onyekachi Onyele [5], Anthony Odinakachukwu Nwadiubu [6]

[1] Federal University of Technology, Owerri, Nigeria
[2] Access Bank Nigeria PLC, Nigeria
[3] Alvan Ikoku Federal University of Education, Owerri, Nigeria
[4] University of Agriculture and Environmental Science Umuagwo, Nigeria
[5] Rhema University, Nigeria
[6] Kingsley Ozumba Mbadiwe University, Ogboko, Nigeria
**Corresponding author E-mail: chijioke.nwadike@futo.edu.ng*

Received: October 20, 2025, Accepted: December 7, 2025, Published: December 16, 2025

Abstract

The change towards clean energy in African continent has become a main concern, reporting the continued energy shortages and discussing the certainty of climate change. This work explores the function of public private partnership (PPPs) in accelerating clean energy transition in continent. The aim of this work includes the evaluation of the regulatory framework, assessing the effect of PPPs and ascertaining policy gaps that dwindle the growth of clean energy development. Secondly the study attracts policy documents and important literature, introducing robust regulatory systems, organizational structures and laws that govern clean energy and PPP in the continent. The analysis was planned on evaluating the effect of current regulatory instruments and recognize the policy gaps that dwindle the smooth accomplishment of PPPs in accelerating clean energy. The major findings revealed that vital role of a well-defined legal frameworks, efficient management of risk and durable community commitment is a successful key factor in deployment of PPPs in clean energy in Africa. This work strongly advice policymakers to focus on the developing a solid regulatory and legal institutions that interests investment and guarantee long term sustainability. It was observed that encouraging risk sharing tools is very significant stride in reducing operational challenges and financial losses. Local communities are expected to have active involvement in unbiased distribution of projects benefits, this is vital in ensuring public recognition and safeguarding long term sustainability. Also diversification and increasing the sources of funds is highlighted as a means to decrease financial risk and prevent reliance on single funding methods. The importance of this work spreads to notifying policy development, protecting investment decision, encouraging community participation, enhancing the project performance, consolidating international collaboration, adding value to academic research, judging environmental impacts and assisting capacity building towards sustaining clean energy transition in Africa.

Keywords: *PPPs; Clean Energy; Renewable Energy and Energy Transition.*

1. Introduction

The global community is suffering a dangerous and accelerated shift towards clean energy. Wood Mackenzie's cutting-edge Energy Transition Outlook projects that attaining net zero emissions by 2050 will demand around US\$3.5 trillion in annual investment [1]. Similarly, the International Energy Agency (IEA) predicts that renewable sources will account for almost 90% of the world's electricity supply by mid-century. Starting from year 2022, it was observed that 46% of worldwide electricity was generated from carbon- free sources while 40% of countries depends on renewables for their needed power. [2], to ensure this discussion is profitable and sustained, it must commit the energy trilemma make sure that it is reliable, lower cost and environmentally friendly. Changing conventional fuels with cleaner alternatives like biofuels or hydrogen is still expensive.

Though, sectors dependent on refined petroleum products and other industries face major hurdles, as they produce high emissions and lack scalable substitutes to fossil-based feedstock. Changing conventional fuels with cleaner alternatives like biofuels or hydrogen is very expensive. Accordingly, fossil fuels remain the principal driver of economic activity in many nations.

The global move from fossil fuels to renewable energy sources is characterized with a lot of issues, the main issue is the huge financial constraints, predominantly the persistence of fossil fuel sponsorships and the difficulty of mobilizing satisfactory investment for renewable energy development. The infrastructural and policy requirements necessary to enable the large-scale integration of alternative energy systems [3] .Currently there is no universal solution that exists for overcoming the complexities of the transition; neither a single technology nor a constant policy framework can fully address the multidimensional energy trilemma of security, sustainability, and affordability. Evolving this transformation requires adequate capital investment, sustained technological innovation, and comprehensive policy as well as regulatory support. Nevertheless debates persist concerning the optimal conduits to decarbonization, there is a broad consensus that active progress hinges on collaborative engagement between public and private sector actors in quest of shared climate objectives.

Public–Private Partnerships (PPPs) present a distinctive opportunity to align the interests of governments, private investors, and broader energy transition objectives. The PPPs is a business venture in which the nations governments should make available supporting policies and how to mitigate the risk, the private sector will take care of the project finance, construction, management and its maintenance. The primary aim is to attract private funds for huge infrastructure, improve energy security, and help in environmental and sustainability objectives [4 and 5].

The word Public –Private Partnerships (PPPs) cannot be simply defined since its structure fluctuates among nations and sectors. Some national governments offer policies that ensure the funding of these projects at the national level, one of the major important is the emerging technologies and infrastructure. Sometimes they allocate task to private firms tap into the expertise or decrease the operating outlay. PPPs are generally accepted worldwide as an instrument conveying public goods and services since they bring together productivity and mutual costs, risk and profits. It was also observed that PPPs signify lasting relationships where public and private entrepreneurs plan together, finance and bring to existence projects, with task and rewards equally shared [6] .

However, the recognition that contracts are inherently incomplete has drawn scholarly attention to the complementary role of personal mechanisms. Research places of interest is that contracting itself is relational in nature, with socially rooted networks and personal interactions exerting important influence on economic exchange [7] and [8].

The increasing demand for clean energy in Africa, joined with the continents ambition for sustainable development has made deployment of renewable energy a top priority. Universally it well known that clean energy is vital for decreasing greenhouse gas emissions whereas energy security and diversification is fortified. [9]. Sequel to this background innovations like smart grids have grown important by talking about the technical challenges which includes the quality of power, management and amalgamation of renewables into current systems. [10] and [11]As of 2022 it was observed that installed renewable energy capacity, China, the United States, and Brazil lead the entire world, with China reaching 1,160,799 MW, followed by the United States (351,676 MW) and Brazil (175,262 MW) [12].

It was observed in 2024, that more than 640 million people in Africa lived without access to electricity, replicating an electrification rate of just above 40% [13] and [14]. Insufficient access to reliable and affordable energy continues to position a substantial restriction for many developing countries, undermining struggles to lessen poverty, escalation of health outcomes, and kindle economic growth [15] and [16] The International Renewable Energy Agency (IRENA) underscores that Africa owns massive renewable energy potential which, if rapidly harnessed, could change the continent's energy landscape. The quick acceptance of clean energy systems would strengthen energy security, increase access to clean cooking solutions, generate sustainable employment and support the creation of resilient economies [17]

The wealth of renewable resources in African endures to resist systemic challenges which include persistent energy poverty, technological limitations, delicate institutional capacity, and the adverse effects of climate change, this delay the Continent's ability to fully leverage its clean energy potential [18]. Several African nations in partnership with international organizations, have introduced projects designed at increasing clean and renewable energy infrastructure across the continent. The African Union's (AU) Agenda 2063 states that renewable energy is a foundation for moving socioeconomic transformation and sustainable development in Africa [19].

With reference to these progress, there is a crucial need to discover and spread on innovative mechanisms such as Public–Private Partnerships (PPPs) to address the fundamental tests and to fast-track the clean energy transition. These methods are very vital in addressing essential challenges and obstacles in establishing renewable energy as a facilitator for sustainable development in Africa.

Ndukwe et al [20] investigated the service delivery in Nigeria's power sector with importance on the functions of PPPs. They evaluated the relationships among customer expectations, service interactions, alternatives, and dissatisfaction, recommending a novel model of service justice. The research believed on an integrated approach to customer protection within managerial frameworks, surpassing isolated retention schemes.

Awuku et al [21] in their study compared PPPs in Ghana's solar energy sector and that of South Africa and Morocco, Pareto efficiency and game theory applauded Ghana's acceptance of governance methods. Their work also pointed out legal precision openness and instruments that reduce principal agent problems

Udeagha & Ngepah [22] examined the impact of public-private partnership investment on carbon emissions in South Africa. Their findings suggest that investment in energy contributes to environmental deterioration. The Environmental Kuznets Curve hypothesis holds, indicating a need for sustainable investments to combat escalating CO2 emissions.

Adelakun et al [23] opined that technological innovations are playing an ultimate role in advancing off-grid renewable energy solutions across Africa. Progress in battery storage, the placement of smart metering systems, and the rise of pay-as-you-go (PAYG) business models are profoundly reducing costs while rising reliability, these technologies are making off-grid energy systems more accessible, resourceful and better suitable to the desires of rural and underserved communities

2. Methodology

This research work adopted a qualitative approach, depending extensively on the investigation of policy documents, institutional frameworks, and relevant academic literature. The study depends on the regulatory environment, institutional arrangements, and policy guidelines leading to clean energy development and Public–Private Partnerships (PPPs) through the African continent. The primary objective was to appraise how effective are the current regulatory tools while spotting policy gaps that frustrate the successful adoption of PPPs in the clean energy sector in Africa. The analysis was structured around nine focal areas: This study used bar charts to elucidate the dynamics of clean energy capacity in Africa while emphasizing notable character of PPPs. The data was sourced from International renewable energy agency, (IRENA 2024) [17]

1) The impact of clean energy infrastructure.

2) An examination of investors and their functions in partnership ingenuities.
3) An evaluation of PPPs' barriers and challenges towards clean energy infrastructure.
4) The issues on PPP regulation and policy frameworks in Africa.
5) An identification of challenges and barriers to effective PPPs implementation.
6) The experiences from fruitful initiatives
7) The experiences from unsuccessful PPPs initiatives

3. Results and Discussion

Figure one.

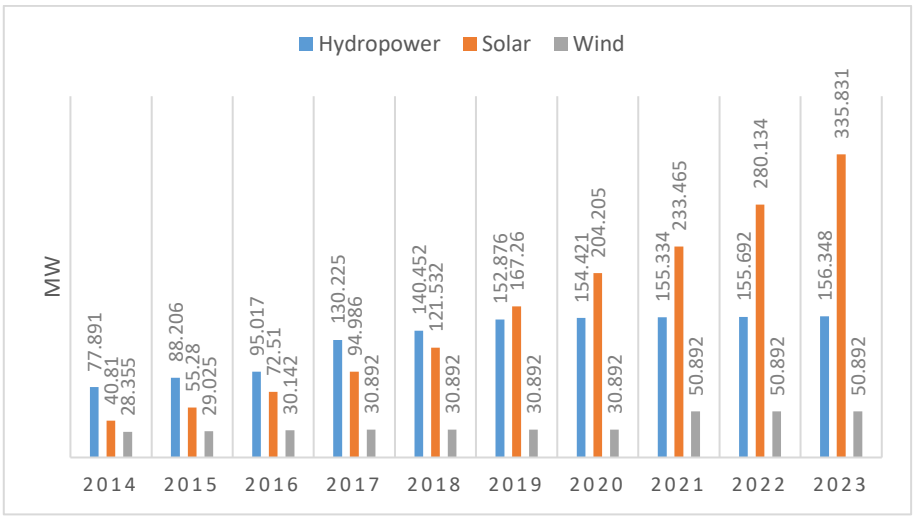

Fig. 1: Total Clean Energy Capacity in Africa, 2014-2023.

Source: IRENA (2024). Off-grid renewable energy statistics. International Renewable Energy Agency, Abu Dhabi.

Figure 1 illustrates Africa's clean energy trend from 2014 to 2023, with emphasis on hydropower, Figure 1, shows the trend of clean energy in Africa ranging from 2014 to 2023, with particular reference to hydropower, solar and wind. It was noted that hydropower remained the major source. It increased from 80 GW in 2014 to about 155 GW in 2023. This growth by 75 GW in 9 years shows that the continents dependence on huge hydro system. This is sustained by many rivers and existing infrastructure. This growth was stable but slower than others sources due to environmental and geographic constraints.

Solar energy was the fastest and highest in expanding, it started with 40 GW in 2014, its growth was rapid and in 2019 it overcome the hydropower and rose to 330 GW in 2023, it increased by 290 GW in 9 years. Solar energy consistent rise in depicts it high potential especially in areas with strong irradiation and grid access limitations.

The wind energy was the slowest in advancement, this is as result of high cost of installation, limited suitable sites for wind turbine and integration of grid issues. As compared with hydropower and solar, the wind energy started between 20 -30 GW in 20214 and increased to 50 GW. The boost was very poor, despite its small portion, the wind energy helps to diversify the mix and strengthen the grid resilience. The overall data presents a great move towards solar, balanced reliance on hydropower and gradually the development of wind energy.

Figure two.

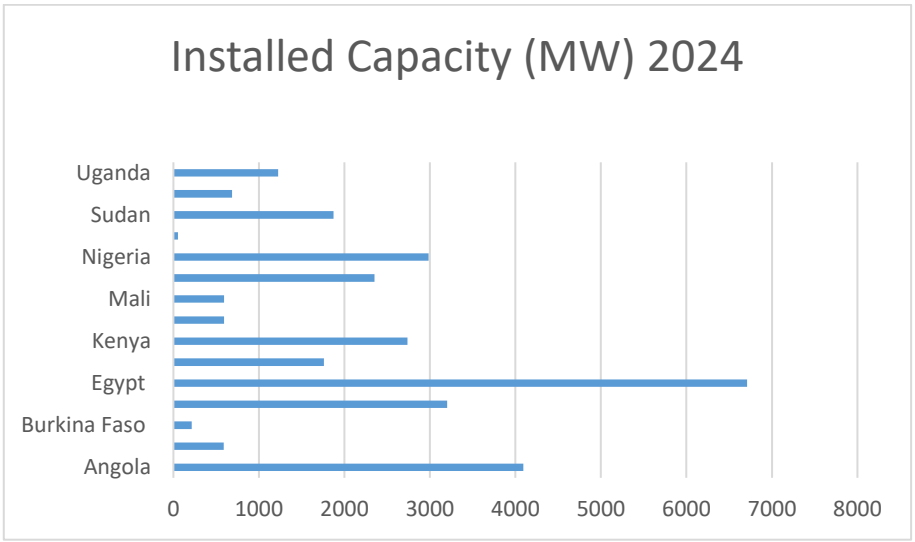

Fig. 2: Top 15 Off-Grid Clean Energy Capacity in African Countries, 2024.

Source: IRENA (2024), Renewable capacity statistics 2024, International Renewable Energy Agency, Abu Dhabi.

Figure 2 presents installed renewable energy capacity in Mega Watts (MW) across selected African nations. It was observed that Egypt was the highest with about 6700 MW, this was achieved through substantial hydropower, solar and wind energy initiatives supported investments. Angola 4100 MW and Nigeria 3000 MW showing adequate growth.
Kenya and Sudan achieved mid-range from 1700 and 2700 MW presenting developmental efforts. Also countries like Uganda, Mali and Burkina Faso, records was the least with figures below 1200 MW indicating low acceptance or small scale installations.
Finally this figure presented indicates that renewable energy capacity is critically focused in the West and North Africa, revealing significant inequalities in the roll out of clean energy in Africa.
Cases of Successful PPP in Clean Energy Transition Projects in Africa
Through Africa, there are several flourishing PPPs that have succeeded in the circle of clean energy transition. As displayed in Table 1, these PPPs have lead diverse clean energy enterprises in Africa, with a principal focus on connecting solar, hydroelectric power, and wind. Major contributors to Africa's clean energy achievements include the 580 MW Noor Ouarzazate Solar Complex located in Morocco, the 310 MW Lake Turkana Wind Power Project in Kenya, and the colossal 1,650 MW Benban Solar Park in Egypt.

Impact of clean energy Infrastructure Figure 3

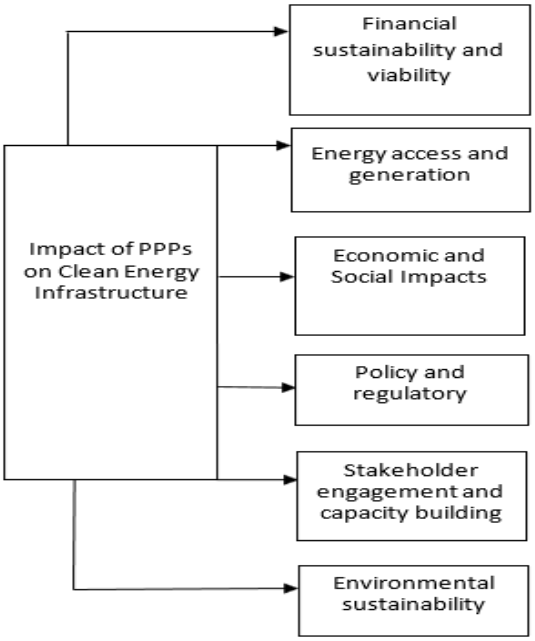

Fig. 3: Above Impact of PPP on Clean Energy, Infrastructure, Evaluating How PPPs Influence Transition to Clean Energy Infrastructure in Africa Is Important for Measuring Its Effectiveness.

Source: Author's computation.

Examining investors and their functions in partnerships ingenuities Figure 4.

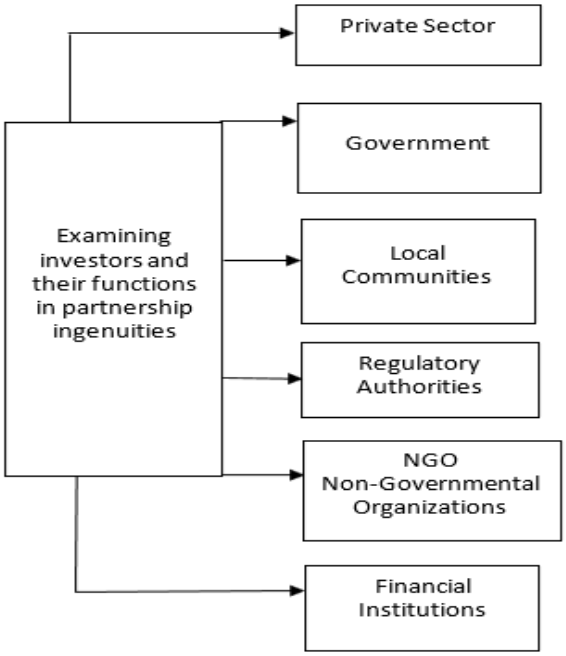

Fig. 4: Above Examines Investors and Their Functions in Partnership Ingenuities in Clean Energy Transaction in Africa.

Evaluation of PPPs barriers and challenges towards clean energy infrastructure.Figure 5.

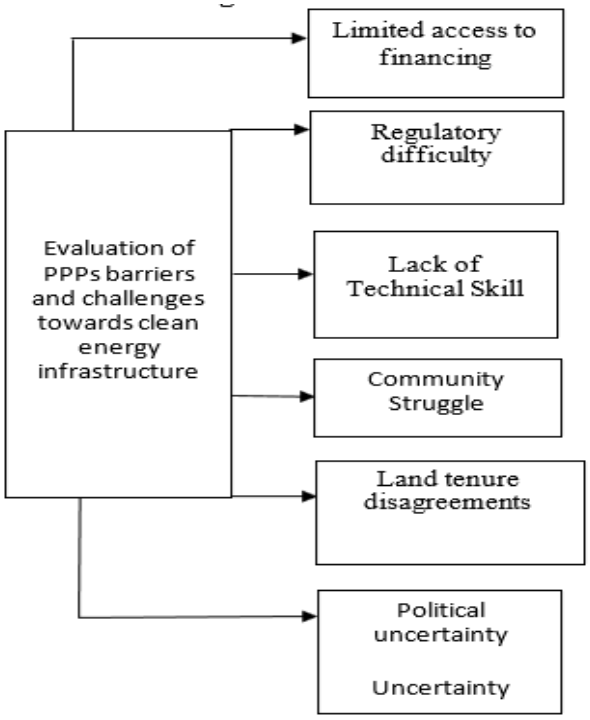

Fig. 5: Presents Evaluation of PPPs Barriers and Challenges Towards Clean Energy infrastructure.

Source: Author's computation.

Issues on PPPs regulations and policy frameworks in Africa..Figure 6

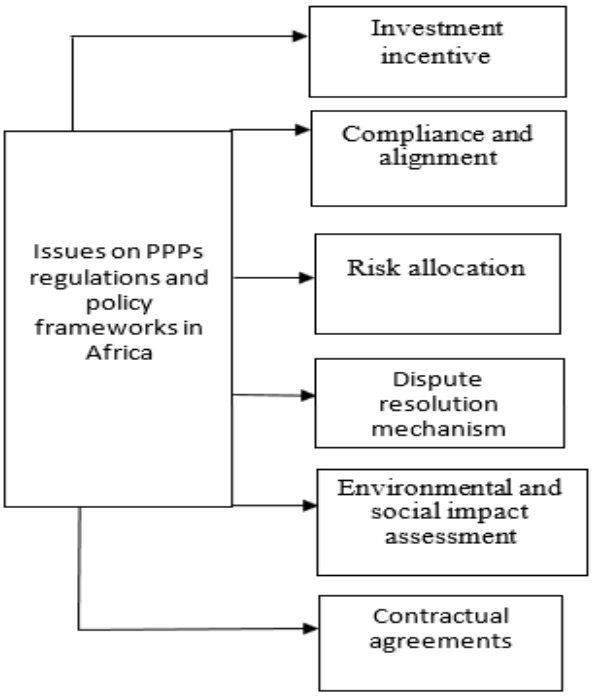

Fig. 6: Above Shows Six Identified Issues on PPPs Regulatory and Policy Frameworks in Africa.

Identification of challenges and barriers to effective PPPs implementation Figure 7.

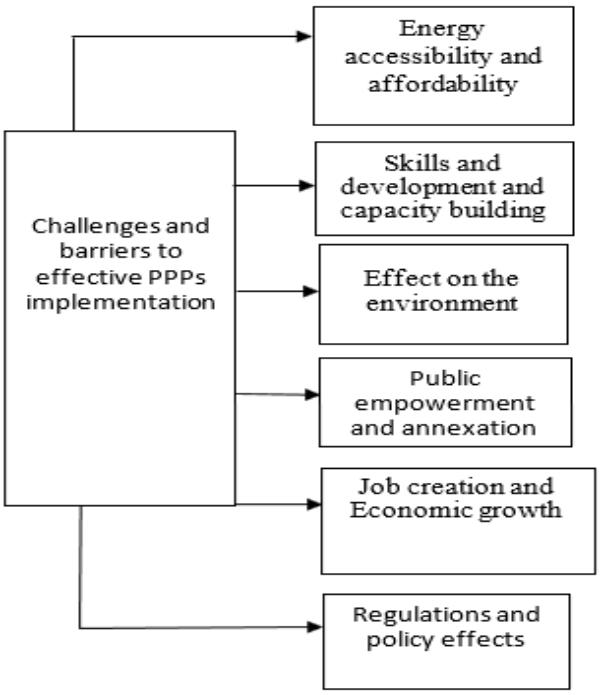

Fig. 7: Presents Identified Challenges and Barriers to Effective PPPs Implementation in Clean Energy Transition in Africa.

Source: Author's computation.

Experience from fruitful PPP initiatives..Figure 8

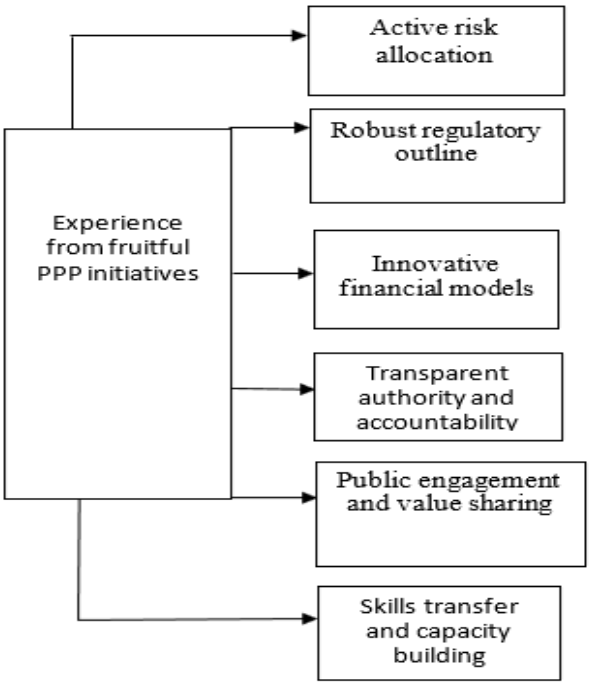

Fig. 8: Shows Experiences from Fruitful PPP Initiatives in Clean Energy Transition in Africa.

Source: Author's computation.

Experiences from unsuccessful PPPs initiatives. Figure 9.

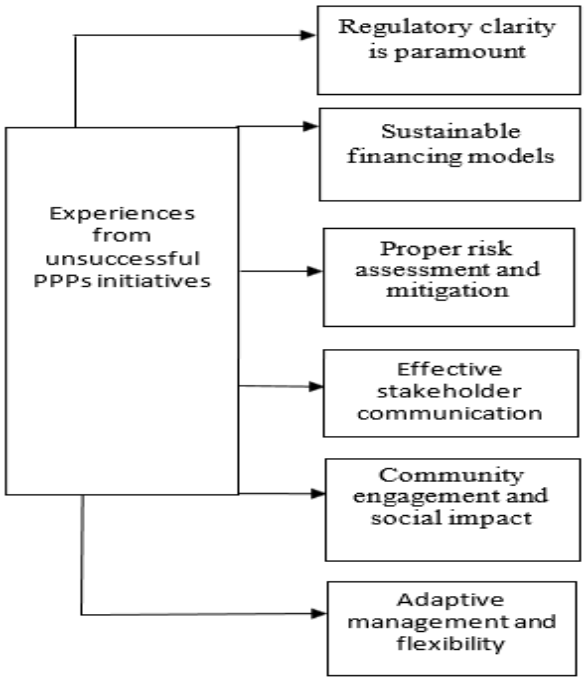

Fig. 9: Presents Six Identified Factors Responsible for Unsuccessful PPPs Initiatives in Clean Energy Transition.

Source: Author's computation

4. Conclusion and Recommendations

This study examines the significance of a defined legal frameworks, risk management effectiveness and participation of communities in a successful transition to clean energy through PPPs in Africa. This investigation recommends policymakers to prioritize the establishment of solid legal and regulatory institutions, which in turn nurture investor autonomy, offer stability and guarantee the continuity of the project. The viability, sustainability and social adoption of clean energy initiatives rest on active community engagement and harnessing the project benefits. In key decision making, local populations should be involved by policymakers and developers to identify their challenges and proffer solutions that bring about ultimate socio economic benefit of the project. Diversification of the financial resources is crucial for reducing the reliance of single streams of income and increase it long term sustainability.

It is proposed that future research should address the complexity of Africa legal and regulatory frameworks, further review the socio economic consequences of the contribution of the community, identify innovative financing methods to ensure the sustainability of the investment, with the combination of policymakers, stakeholders, community members and investors, the African continent can unlock is wealth of clean energy, thus advancing the variability, development, growth and energy security in the growing Africa's population.

References

[1] McKenzie W, Energy transition outlook: 2024-25 update. https://www.woodmac.com/market-insights/topics/energy-transition-outlook/. 2024.
[2] Adelakun NO, Kuponiyi DS, Olajide MB,Odeyemi CS, Assessing the impact of public-private partnerships on renewable energy development in Africa. *International Research Journal of Modernization in Engineering Technology and Science, 6*(2), 3094-3105.
[3] Yin C, Qamruzzaman M, Empowering renewable energy consumption through public-private investment, urbanization, and globalization: Evidence from CS-ARDL and NARDL. *Heliyon. 10*(4):e26455. https://doi.org/10.1016/j.heliyon.2024.e26455.
[4] Fu Q, Gong, Q, Zhao, XX, Chang CP, The effects of international sanctions on green innovations. *Technological and Economic Development of Economy, 29*(1), 141-164. 2023. https://doi.org/10.3846/tede.2022.17782.
[5] Omolola SA, Adelakun NO, the relevance of doubly-fed induction generator (DFIG) in modelling and simulation of a grid connected based wind turbine system. *International Journal of Engineering Technology and Management Science, 4*(6), 41-47. https://doi.org/10.46647/ijetms.2020.v04i06.009.
[6] Mu R, Wu PY, Haershan M, Pre-contractual relational governance for public-private partnerships: how can ex-ante relational governance help formal contracting in smart city outsourcing projects? *International Review of Administrative Sciences,* 1-17. 2021. https://doi.org/10.1177/00208523211059643.
[7] Osei-Kyei R, Chang APC, Review of studies on the critical success factors for public-private partnership (PPP) projects from 1990 to 2013. *International Journal of Project Management, 33,* 1335-1346. 2015. https://doi.org/10.1016/j.ijproman.2015.02.008.
[8] Panda DK, Public private partnerships and value creation: the role of relationship dynamics. *International Journal of Organizational Analysis, 24*(1), 162-183. 2016. https://doi.org/10.1108/IJOA-12-2014-0830.
[9] Adelakun NO, Olanipekun BA, A review of solar energy. *Journal of Multidisciplinary Engineering Science and Technology (JMEST), 6*(12). 11344 – 11347. https://doi.org/10.2139/ssrn.3579939.
[10] Ibitoye, OT, Onibonoje, MO, Dada, JO, Analysis of power quality and technical challenges in grid-tied renewable energy. *WSEAS Transactions on Power Systems, 18*, 248-258, https://doi.org/10.37394/232016.2023.18.26.
[11] Olanipekun, BA, Adelakun NOAssessment of renewable energy in Nigeria: challenges and benefits. *International Journal of Engineering Trends and Technology, 68*(1), 64-67. https://doi.org/10.14445/22315381/IJETT-V68I1P209.
[12] Fernández L, Renewable energy capacity 2022 by country, https://www.statista.com/statistics/267233/renewable-energy-capacity-worldwide-by-country, 2023.
[13] AfDB, Supporting a clean energy transition. https://www.afdb.org/sites/default/files/news_documents/ader_2024_-_chapter_1_en.pdf, 2023.
[14] Statista, Primary energy consumption worldwide in 2024, by country. https://www.statista.com/statistics/263455/primary-energy-consumption-of-selected-countries/ 2024.

[15] Adelakun NO, Omolola SA, Olajide MB, Off-grid renewable energy transition in selected countries in Africa: Challenges and opportunities for sustainable development. Paper presented at the 2nd Malaysia Sustainability University Network National Conference 2022, December 6th & 7th, Universiti Putra Malaysia, Malaysia. https://international-sustainable-campus-network.org/2nd-malaysia-sustainable-university-network-national-conference. 2022.
[16] Garba I, Bellingham R. Energy poverty: Estimating the impact of solid cooking fuels on GDP per capita in developing countries-Case of sub-Saharan Africa. Energy, 221, 119770. https://doi.org/10.1016/j.energy.2021.119770.
[17] IRENA, Renewable capacity statistics 2023. International Renewable Energy Agency, Abu Dhabi. www.irena.org/Data, 2023.
[18] Salman M, Zha D, Wang G, (2022). Assessment of energy poverty convergence: A global analysis. *Energy,* 255, 124579. https://doi.org/10.1016/j.energy.2022.124579.
[19] Obobisa ES, Chen H, Mensah IA, The impact of green technological innovation and institutional quality on CO2 emissions in African countries. *Technological Forecasting and Social Change, 180,* 121670. https://doi.org/10.1016/j.techfore.2022.121670.
[20] Ndukwe C, Idike AN, Ukeje IO, Okorie, CO, Onele JC, Richard-Nnabu NE, Kanu C, Okezie BN, Ekwunife RA, Nweke CJ, Nwangbo SO, Public private partnerships dynamics in Nigeria power sector: Service failure outcomes and consumer dissonance behaviour. *Public Organization Review, 23*, 623–646. https://doi.org/10.1007/s11115-021-00579-5.
[21] Awuku SA, Bennadji A, Muhammad-Sukki F, Sellami N, Promoting the solar industry in Ghana through effective public-private partnership (PPP): Some lessons from South Africa and Morocco. *Energies, 15,* 17. https://doi.org/10.3390/en15010017.
[22] Udeagha, M. C., & Ngepah, N. (2023). Can public–private partnership investment in energy (PPPI) mitigate CO2 emissions in South Africa? Fresh evidence from the novel dynamic ARDL simulations approach. Frontiers in Environmental Science, 10, 1044605. https://doi.org/10.3389/fenvs.2022.1044605.
[23] Adelakun, N.O, Omolola, S.A, Ayanlowo, O.F (2024) Assessment of off – grid renewable in selected African Countries. Proceedings of the 2nd International Facilities Engineering & Management Conference, Exhibition, AGM (IFEMCE 2024), The Nigerian Institution of Facilities Engineering and Management, 1st – 2nd, 2024.