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Renewable energy: A lever for a sustainable future in Africa

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Abstract

Drawing on documented evidence and an analysis of ongoing projects, this paper elucidates the benefits, challenges, and socio-economic impacts of renewable energy on rural communities in Africa. It further argues that, despite limitations in infrastructure and financing mechanisms, the growing influx of investments in digital technologies presents a pivotal opportunity for sustainable development across the continent. Moreover, the analysis compares how countries such as Senegal and Ethiopia have capitalized on their renewable energy potential through differing regulatory frameworks and financing models.

Keywords: Renewable energy; Rural communities; Africa; Sustainable development; Technological investments

1. Introduction

Africa confronts a dual challenge: catering to the ever-increasing energy demands of its population while simultaneously mitigating its carbon footprint. Currently, over 600 million individuals lack access to electricity, a significant impediment to economic and social development [1]. Moreover, reliance on fossil fuels, particularly oil and coal, exacerbates greenhouse gas emissions and contributes to global climate change [2]. This underscores the necessity of adopting renewable energy as a cornerstone of sustainable development.

Africa's untapped potential in solar, wind, hydroelectric, and biomass energy is immense, with solar irradiation far surpassing the continent's energy requirements [3]. For instance, the vast solar potential of the Sahara Desert could, on its own, generate sufficient energy to power the entirety of Europe [4]. However, despite these strengths, the continent remains far from realizing its full potential due to inadequate infrastructure, limited funding, and insufficient regulatory frameworks [5].

This paper seeks to analyze recent progress in the adoption of renewable energy in Africa, focusing on concrete examples, particularly in Senegal and other West and Central African countries. By highlighting the socio-economic benefits and the remaining challenges, this analysis aims to contribute to the discourse on strategies for a successful energy transition. Furthermore, the comparison of differing regulatory environments will shed light on the role of governance in the success of renewable energy projects.

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2. Methodology

Our analysis centers primarily on the socio-economic and environmental impacts of solar and wind projects in Senegal, hydroelectric projects in the Democratic Republic of Congo (DRC), and biomass projects across West Africa. The data used in this study are drawn from reliable sources, including the International Renewable Energy Agency (IRENA), the World Bank, and specific case studies. Quantitative data are sourced from public databases such as the International Energy Agency (IEA) and REN21.

This study highlights the influence of political frameworks and funding models on project success by comparing key projects from Senegal and Ethiopia. In particular, Senegal's success in developing solar and wind energy stems from proactive government policies, while Ethiopia's reliance on hydroelectric power illustrates the role of natural resources and infrastructure investment.

3. Result and discussion

The comparative analysis between Senegal, Ethiopia, and other African countries reveals differing dynamics in the implementation of renewable energy projects. Senegal has adopted a proactive approach, as demonstrated by initiatives such as the Bokhol solar power plant, while Ethiopia has capitalized on its abundant hydroelectric potential. Key challenges, however, include infrastructure development, financing management, and workforce training. For instance, while Ethiopia's hydroelectric expansion has benefited from state-backed investments, Senegal has succeeded by attracting foreign direct investment and forming public-private partnerships. These differing approaches highlight the importance of adaptable policy frameworks and the need for diversified funding sources.

Senegal emerges as a leading example of renewable energy development in West Africa. The Bokhol solar power plant, inaugurated in 2016 with a capacity of 20 MW, currently supplies electricity to approximately 160,000 households and significantly contributes to the national target of integrating 30% renewable energy into the country's energy mix by 2025 [6]. This project, along with similar initiatives, has created hundreds of direct and indirect jobs, particularly in rural areas.

3.1. Economic and Policy Implications

Government support in the form of subsidies, favorable tariffs, and regulatory incentives is crucial for the success of renewable energy projects. Senegal's regulatory framework has encouraged foreign investment and facilitated the growth of solar and wind projects, while Ethiopia's success in hydroelectric energy stems from significant state control and investment in large-scale infrastructure. The differences in regulatory approaches between these countries underscore the need for flexible governance models that can adapt to a country's specific resource base and socio-political environment.

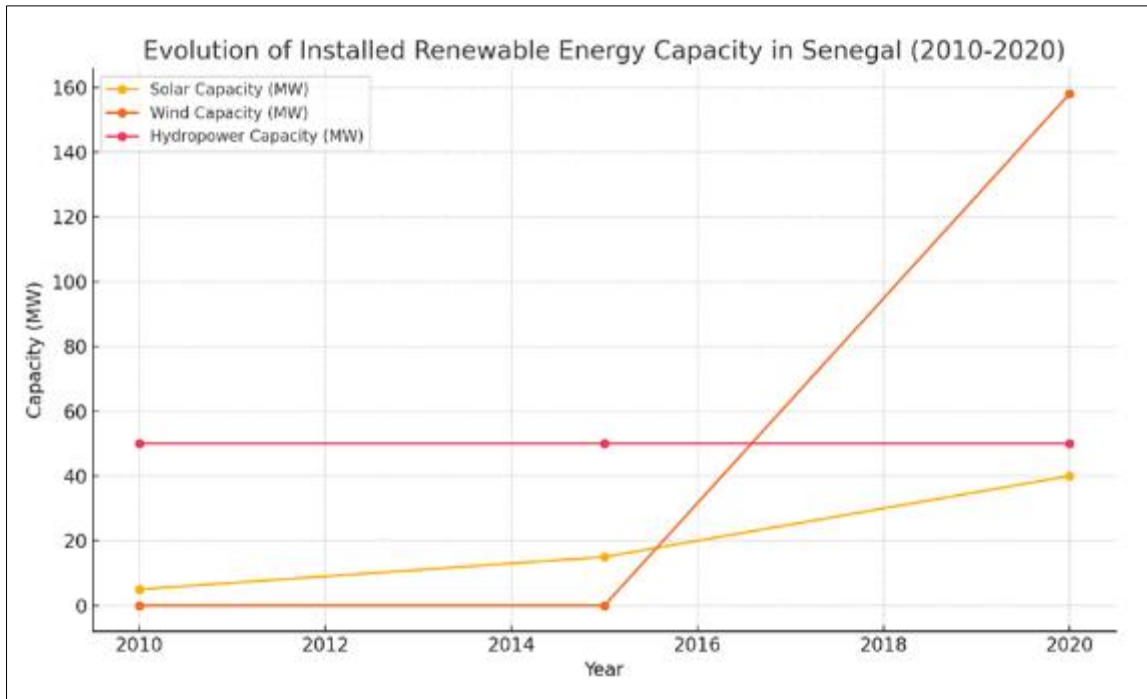


Figure 1 Evolution of Installed Renewable Energy Capacity in Senegal (2010-2020)

The figure 1 shows a substantial increase in solar capacity from 2015, followed by the development of the Taïba Ndiaye wind farm starting in 2018. Hydroelectric capacity remained stable during this period.

Table 1 Comparison of Major Renewable Energy Projects in West Africa

Projet	Country	Energy Type	Capacity (MW)	Year	Households Supplied	Jobs Created
Bokhol Solar Power Plant	Sénégal	solar	20	2016	160000	200
Taïba Ndiaye Wind Farm	Sénégal	wind	158	2019	2000000	500
Nzema Solar Power Plant	Ghana	solar	155	2013	100000	300
Cabeólica Wind Farm	Cap-Vert	wind	26	2011	50000	100

Table 1 highlights the impact of renewable energy projects on job creation and household energy supply in several West African countries. Senegal, with the Bokhol and Taïba Ndiaye power plants, is a leader in this field, having provided energy to millions of people while creating significant employment opportunities.

Table 2 Growth of Installed Renewable Energy Capacity in Africa

Country	Capacity in 2010 (GW)	Capacity in 2020 (GW)	Growth (%)	Dominant Source
Senegal	1	3	200	Solar, Wind
South Africa	5	10	100	Solar, Wind
Ethiopia	2	7	250	Hydroelectric
Kenya	1,5	4	167	Geothermal, Solar

Table 2 shows the rapid growth of renewable energy in several African countries. Ethiopia, in particular, experienced a 250% increase in its installed capacity between 2010 and 2020, mainly due to hydroelectric power. Senegal also recorded impressive growth, largely driven by the expansion of solar and wind capacities..

4. Conclusion

Africa, particularly Senegal, is at a pivotal moment in its energy transition. To fully unlock the vast potential of renewable energy, African governments must persist in attracting substantial investments while simultaneously overhauling regulatory frameworks to foster long-term sustainability. Strong public-private partnerships, better financing management, and large-scale training programs are essential to ensuring lasting success.

Moreover, the development of renewable energy offers an unprecedented opportunity to address Africa's growing energy needs while stimulating economic growth, creating jobs, and reducing energy poverty. Senegal, with projects such as the Bokhol solar power plant and the Taïba Ndiaye wind farm, is leading the way, but increased efforts are required to ensure universal access to sustainable energy across the continent. A coordinated policy response, backed by robust funding mechanisms and transparent governance, will be essential to overcoming the infrastructure and financing challenges that currently hinder large-scale deployment.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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