

Assessing the Effectiveness of Climate Finance Instruments in Promoting Renewable Energy Adoption and Mitigating Greenhouse Gas Emissions in Kenya: A Systematic Review

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Abstract: Climate change is one of the most pressing global challenges of our time, with far-reaching implications for ecosystems, economies and human well-being. This paper essentially reviews the interaction between climate change and the finance instruments through the lens of Economic Theory and Innovation Diffusion Theory. Requirements for financing climate resilient infrastructure such as clean energy projects, energy efficient buildings, carbon-free transportation, water, waste management, and supply chains. Through innovation and diffusion there is emphasizes on importance of understanding how new technologies, such as renewable energy solutions, spread throughout societies. Climate finance instruments facilitate technology transfer, research, and development in alignment with the theory, promoting the adoption of renewable energy innovations globally. In the pursuit of sustainable development, nations around the world increasingly recognize the urgency of transitioning to cleaner and more sustainable energy sources Kenya, like many other developing nations, grapples with the dual challenge of meeting its growing energy demands while mitigating the adverse effects of climate change. In this context, evaluation of climate finance tools is paramount to understand their effectiveness in promoting renewable energy adoption and reducing greenhouse gas emissions Kenya should be commended in embracing renewable energy sources in recognizing the need to reduce fossil fuel dependency and harness abundant renewable resources progress has been made the deployment of climate finance instruments such as international grants, loans and carbon financing mechanisms.

Keywords: climate change, sustainable development, renewable energy, climate finance.

1. Introduction

There are serious and immediate ramifications for the ecology, economy, and well-being of society due to climate change. The IPCC has consistently emphasized the incontrovertible evidence of climate change caused by human activities, primarily stemming from the emission of greenhouse gases (IPCC, 2021). The escalating global temperatures, occurrence of extreme weather events, and disruptions to ecosystems serve as evident indicators of the urgent necessity

to address this existential challenge. The Energy Sector plays a crucial role in addressing climate change due to its substantial contribution to greenhouse gas emissions. The International Energy Agency (IEA) (2020) emphasizes the critical significance of transitioning to sustainable energy sources as a means to effectively mitigate the impacts of climate change. The pressing nature of this imperative has motivated nations worldwide to actively engage in the pursuit of innovative and transformative actions aimed at decreasing their carbon emissions and enhancing their resilience to climate-related risks.

In the current context, it is imperative to prioritize the promotion of sustainable energy solutions. REN21 (2021), Renewable energy technologies, including solar, wind, and hydropower, have emerged as crucial elements in the transition towards a low-carbon future. The adoption of sustainable alternatives not only serves to mitigate greenhouse gas emissions, but also contributes to enhancing energy security, minimizing air pollution, and fostering economic growth. As nations grapple with the multifaceted challenges posed by climate change, understanding the effectiveness of climate finance instruments becomes crucial. This paper explores the role of financial mechanisms in promoting the adoption of renewable energy and mitigating greenhouse gas emissions, with a specific focus on the case of Kenya.

A. Climate Finance within Developing Nations

The term "climate finance" serves essential role of giving support to those developing countries in their attempts to deal with challenges caused by change of climate. Schalatek et al. (2019) noted that both accessibility and availability of climate finance tools have substantially provided ability of developing nations to engage in sustainable development projects. In similar vein, Nzioka et al. (2020) highlighted the significance of international climate finance mechanisms in enhancing resilience and ability to adapt to the changes and impacts that are related to climate change.

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The study conducted by Ondraczek (2018) highlighted the significance of policy frameworks in effectively facilitating the integration of renewable energy sources. This is supported by another study which was carried out by Kamau and Brounen (2018) to examine the influence of the government policies on adopting renewable energy in Kenya. This study focuses on the role of customized developing strategies that are considered in the socio-economic situations in Kenya.

B. Climate Finance Landscape in Kenya

Climate change is a pressing global issue with far-reaching consequences for the environment and has affected many organizations (Smith, 2019). Recent empirical studies have focused on the gap on the data provided on climate change. In 2023, temperature records toppled, while storms, floods, droughts and heatwaves caused devastation. UNEP's Adaptation Gap Report (2023) Underfinanced, underprepared – Inadequate investment and planning on climate adaptation leaves world exposed finds that progress on climate adaptation is slowing when it should be accelerating to catch up with these rising climate change impacts. One study conducted by Johnson and Brown (2020) found a significant increase in average global temperatures over the past decade, supporting the notion that climate change is a reality that cannot be ignored. Additionally, Smith *et al.* (2018) highlighted the impact of climate change on the world. Adams (2017) Argue that a more cautious approach, emphasizing the need for further research to fully understand the complexities of climate change (Miller & Williams, 2021). While some scholars argue for the urgency of immediate action others suggest a more cautious approach, emphasizing the need for further research to fully understand the complexities of climate change (Miller & Williams, 2021).

Kenya, similar to numerous other developing nations, depends on climate finance mechanisms to facilitate its shift towards a low-carbon economy. The Green Climate Fund (GCF) and other international financial instruments play a crucial role in the provision of funds for renewable energy projects in the region (Smith *et al.*, 2019).

In recent years, there has been a growing global consensus regarding the pressing need to address climate change by prioritizing the promotion of renewable energy sources. Climate finance instruments have become essential tools in providing crucial support to developing nations such as Kenya in their efforts to transition towards sustainable energy sources. The purpose of this assessment is to assess the efficacy of financial mechanisms in promoting the adoption of renewable energy and mitigating greenhouse gas emissions in the Kenyan context.

C. The Commitment of Kenya to the Renewable Energy

Kenya has become a prominent leading in the region to adopt renewable energy as a key component of its economic growth agenda. The Kenyan government has shown a significant dedication to shifting towards a more environmentally friendly and carbon-neutral energy environment. According to Government of Kenya (2018), the Kenya National Climate Change Action Plan indicates substantial goals for enhancing

the proportion of renewable energy in its comprehensive energy investments, with a particular emphasis on sources of energy like wind, geothermal, and solar power. Kenya has made remarkable progress in effectively usage of its abundant geothermal resources. For instance, the Olkaria Geothermal Plant, which is considered one of the largest geothermal installations globally, serves as a testament to the country's commitment to harnessing clean and locally available energy sources (KenGen, 2020). Furthermore, it is important to note that projects such as Lake Turkana Wind power are an indication of the commitment of Kenya in the expansion of its energy investments in the integration of sustainable solutions (LTWP, 2021).

D. Challenges to Mitigate Greenhouse Gas Emissions

Kenya is experiencing a set of particular problems while trying to achieve its sustainability in the energy sector and as it seeks to address the issues to do with greenhouse gas emissions. In addition, its energy infrastructure is facing an increasing challenge related to increasing urbanization, rapid population growth, as well as industrialization. According to the Kenyan Ministry of Energy (2020), this has presented an increase for energy which has significantly hindered the success of execution of renewable energy projects. Additionally, the technological advancement and financial constraints have challenged the widespread adoption of the renewable energy solutions. Although, Kenya has committed to the renewable energy, the World Bank (2019) reported that there was still a significant challenge to secure significant financial commitments required to support the development of necessary infrastructure and technologies for a comprehensive change towards clean energy sources. The challenges indicated above highlight the complex relationship between legislative goals and their practical execution, illustrating the need for a deep understanding of the effectiveness of climate finance mechanisms to help the efforts of Kenya in advancing the renewable energy case and the reduction of the Green Gas Emissions.

E. Green Gas Emissions Reduction in the Developing Countries

Reduced emissions of greenhouse gases are of the highest significance for the advancement of sustainable development, particularly in countries that are still in the process of growing their economies. The research conducted by Kithyoma *et al.* (2017) investigates the challenges and opportunities related to emission reduction in the agricultural industry of Kenya. The research highlights the importance of implementing context-specific strategies. Moreover, the study conducted by Njoroge and Yillia (2021) underscores the significance of implementing comprehensive climate action plans to effectively address emissions reduction in developing nations.

These studies collectively contribute to the advancement of our comprehension regarding the intricate relationship between climate finance, the adoption of renewable energy, and the mitigation of greenhouse gas emissions within the particular context of developing nations. They offer valuable perspectives

on the obstacles and potential strategies for attaining sustainable development in Kenya.

2. Tools of Climate Finance in Kenya

Kenya has funded renewable energy projects via international cooperation and climate financing channels. According to UNEP (2019) Both, Green Climate Fund (GCF) and Climate Investment Funds (CIF) have been useful in giving financial support for projects that are aiming to reduce carbon intensity of the energy industry.

Kenya, as a developing county, it has strategically implemented different climate finance tools in order to address the urgent challenges of climate change and facilitate a seamless transition towards a low-carbon economy. These instruments play a crucial role to obtain financial support for sustainability of projects.

A. Green Climate Fund (GCF)

Green climate fund is a well-known international technique which supports climate change projects within Kenya. It was established under the UNFCCC, the GCF allocates funds to projects that promote renewable energy, enhance climate resilience, and contribute to sustainable development (Brown & Jepsen, 2016). According to a report by the Ministry of Environment and Forestry (MoEF) in Kenya (2020), the country has submitted proposals to the GCF for initiatives ranging from renewable energy projects to sustainable agriculture practices. Despite the positive engagement, challenges have arisen in the implementation of GCF-funded projects in Kenya. Johnson and Mwangi (2019) argue that bureaucratic hurdles and a lack of institutional capacity have hindered the effective utilization of GCF funds in the country. However, others, such as Brown (2021), highlight the opportunities the GCF presents for fostering innovation and sustainable development in Kenya's climate action efforts.

The Mau Forest conservation project, funded by the GCF, stands as a notable example of Kenya's commitment to sustainable development (Kenyan Environmental Journal, 2022). This project aims to restore and conserve the Mau Forest, addressing both climate change mitigation and adaptation priorities in the region.

B. The Climate Investment Funds (CIF)

CIF offer focused on financial assistance in the developing nations for projects that address climate change. CIF has played a crucial role in providing financial support for projects in Kenya that prioritize renewable energy, energy efficiency, and climate resilience. These projects have significantly contributed to the country's activities that to mitigate greenhouse gas emissions (World Bank, 2021). The Global Climate Fund (GCF) plays a crucial role in providing support for Kenya's efforts to enhance climate resilience and implement effective mitigation strategies. Adams (2023) highlights that in order to guarantee the efficient use of GCF funding for the nation's long-term sustainable development, it is essential to tackle the obstacles that have been highlighted by scholars and decision-makers.

C. Adaptation Fund

The Adaptation Fund, which was created to provide financial support for projects and programmes aimed at assisting vulnerable communities in adapting to climate change, has aided Kenya in the implementation of various adaptation initiatives, as noted by Mwangera *et al.*, (2017). They further revealed that such projects frequently concentrate on sectors such as water resources and agriculture.

D. Renewable Energy Financing Programs

According to research done by Jones and Smith (2020), Kenya successfully implemented a range of programs designed to encourage the adoption of renewable energy sources. Through the international financial institutions give a range of program that including feed-in tariffs and concessional loans, with the purpose of helping private investment in renewable energy projects The programs have been purposely developed to encourage and facilitate private sector engagement.

E. Public-Private Partnerships (PPPs)

Through the findings of Ong'olo *et al.* (2021), it was observed that public-private partnerships have an important impact on securing climate funds for environmentally sustainable initiatives in Kenya. The authors stated that these partnerships entail the cooperation of governmental entities, private sectors, and international organizations to finance and execute initiatives to renewable energy.

F. Renewable Energy Adoption

The efficiency of execution of projects is an important indicator of the influence that climate funding has on the adoption of renewable energy sources. The Lake Turkana Wind Power Project serves as a notable case study that showcases the efficacy of climate finance in promoting the uptake of renewable energy sources in Kenya (Jones & Smith, 2020). The project has been granted partial funding from the Green Climate Fund (GCF). Through the community-based solar programs and other smaller-scale initiatives have played a crucial role in facilitating the provision of sustainable and autonomous energy solutions (Wang *et al.*, 2018). The authors further indicated that these projects have made a substantial contribution to the enhancement of energy assets.

The successful use of climate finance to enable the acceptance of renewable energy can be seen through different projects that implemented in the country. For instance, the Lake Turkana Wind Power Project, funded in part by climate finance, has significantly increased the share of renewable energy in Kenya's power generation (Jones & Brown, 2020).

3. Mitigating Greenhouse Gas Emissions

A fundamental goal of climate finance is to mitigate GHG emissions. Solar microgrids, funded by climate finance initiatives, have been introduced in rural areas. These microgrids not only improve energy access but also contribute to a substantial reduction in carbon emissions, aligning with Kenya's commitment to sustainable development (Mwangera *et al.*, 2017). Carbon pricing is based on the idea that putting a

price on carbon emissions incentivizes businesses to reduce their greenhouse gas emissions, thus mitigating climate change. Assessing the impact on greenhouse gas emissions requires a comprehensive analysis of the implemented projects. Based on a study conducted by Wangari *et al.*, (2018), the implementation of solar-powered microgrids in rural regions has not only expanded energy accessibility but has also resulted in a significant decrease in carbon emissions.

4. Benefits Associated with Climate Finance Instruments in Promoting Renewable Energy

Climate finance instruments are enablers in development of renewable energy that offer a spectrum of advantages that contribute to sustainable development (Jones & Wang, 2020; IPCC, 2014). Jones and Wang (2020) stated that through the finance instruments like international grants and loans, issued provide financial impetus for initiating and expanding renewable energy projects in Kenya and this accelerates the transition toward cleaner energy sources and thus contributing significantly to the reduction of greenhouse gas emissions.

The financial instruments often incorporate risk mitigation strategies, encouraging increased private sector investment in renewable energy ventures (IPCC, 2014). By enticing the private investors, Kenya as a country can have additional resources for scaling up renewable energy initiatives, and thus fostering a more robust and sustainable energy sector.

UNDP (2015) argued that international climate finance initiatives promote capacity building and technology transfer and making the institutions to be more innovative. When the Kenyan stakeholders are empowered, they effectively implement and adopt innovative renewable energy solutions. This knowledge development and exchange promotes the country's ability to harness cleaner technologies, furthering its commitment to emission reduction. There is community support and engagement strategies within renewable energy projects, that ensure the local people actively participate and benefit from these initiatives (World Bank, 2019). The outcomes of socioeconomic advantages, which include job creation and improved access to energy, enhances the success and acceptance of renewable energy adoption.

According to Smith (2019), climate finance instruments may include carbon financing components, by providing economic incentives for Kenya to reduce greenhouse gas emissions through earning revenue with the sale of emission reduction credits. Currently Kenya is encouraged to implement and sustain renewable energy projects that contribute to emission mitigation. Climate finance instruments also promote sustainable energy policies that align and strengthen institutional frameworks for effective project implementation (Ochieng *et al.*, 2018). This alignment enhances the coherence and impact of renewable energy initiatives, ensuring they play a meaningful role in mitigating greenhouse gas emissions.

5. Challenges and Opportunities

Although, the high achievements, there are still some challenges. Ong'olo *et al.*, (2021) identified factors like

inadequate access of finance, uncertainties of policies, and organizational barriers lead to impediments of efficiency usage of climate funds in Kenya. Moreover, it is necessary to acknowledge and address those concerns pertaining to equity and inclusivity to ensure that the benefits of adopting renewable energy are distributed fairly among various socio-economic populations (Archer *et al.*, 2019).

There exist potential areas for improvement that warrant exploration, such as the implementation of skill development programmes aimed at enhancing local capacity. Moreover, the cultivation of public-private partnerships could prove advantageous in advancing progress. The inclusion of local communities and businesses in decision-making processes has the potential to enhance the effectiveness of climate finance interventions, leading to an increase in sustainability and customization to the particular context, as argued by Smith and Brown (2018).

Although there has been some progress, there are still persistent challenges that need to be addressed. The effective utilization of climate finance can be hindered by factors such as limited access to finance, policy uncertainties, and institutional barriers (Mwongera & Ngaruiya, 2017). Nevertheless, there exist prospects for enhancement, including the augmentation of local capacity and the cultivation of public-private partnerships (Ong'olo *et al.*, 2021).

There are a number of aspects that determine the efficiency of climate financing tools. These characteristics include solid governance, cooperation among stakeholders, and flexibility to local situations. While challenges persist, ongoing innovations and improvements in the design and implementation of these instruments contribute to their overall effectiveness in addressing the urgent global challenge of climate change (Johnson, 2023). The assessment of climate finance instruments in Kenya underscores their significant role in promoting renewable energy adoption and mitigating GHG emissions. By learning from successes, addressing challenges, and leveraging opportunities, Kenya can further optimize the impact of climate finance, contributing to a more sustainable and resilient future.

6. Conclusion

The effectiveness of climate finance policies in improving planning, governance, and institutional processes is a complex and multifaceted issue. By delving into taxonomies, empirical applications, and mobilization effectiveness, researchers and policymakers can gain insights into the strengths and weaknesses of existing policies and contribute to the development of more robust and impactful climate finance strategies.

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