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ASSESSING THE IMPACT OF CLIMATE FINANCE ON SOUTH AFRICA'S ECONOMY: A QUANTILE REGRESSION ANALYSIS

Oluwatoyin Esther Akinbowale*, Mulatu Fekadu Zerihun* & Polly Mashigo***

ABSTRACT

This study investigates the efficacy of climate finance in mitigating the adverse effects of climate change on various sectors of the South Africa's economy. Leveraging secondary quantitative data from the South African Climate Finance Landscape Report, this research employs quantile regression modeling in the Statistical Package for Social Sciences (SPSS) 2022 to examine the heterogeneous impacts of climate funding across different sectors. The findings reveal that the effects of climate finance vary significantly across quantile levels, underscoring the need for deliberate policy interventions. This study contributes to the growing body of literature on climate finance and offers evidence-based recommendations to support South Africa and other countries in Africa in achieving an inclusive, climate-resilient, and sustainable economy.

Keywords: Climate change, Climate finance, Climate resilient and sustainable economy, Quantile regression.

1. INTRODUCTION

South Africa is one of the most unequal economies in the world, having a Gini coefficient of 0.63 as at 2014.[1,2] (The Gini coefficient is a statistical measure of the degree of variation or inequality in family or national income

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1 Worldbank group (2024). Gini index. [Online] Available https://data.worldbank.org/indicator/SI.POV.GINI?skipRedirection=true&view=map [Accessed 26th July, 2024]

2 Central Intelligence Agency CIA (2024). Gini index coefficient-distribution of family income [Online] available at: https://www.cia.gov/the-world-factbook/field/gini-index-coefficient-distribution-of-family-income/country-comparison/ [Accessed 26th July, 2024].

distribution). The country is faced with the challenge of inequality, uneven distribution of income, unemployment and poverty rates with significant people who are majorly dependent on subsistence farming for food security[3].

Climate change impacts the socio-economic environment, natural ecosystem, individuals, infrastructures etc. negatively, hence, the need for effective mitigation. Moreover, there is a global drive towards a low-carbon transition and new approaches are required to build climate resilience while promoting an inclusive and sustainable economy. The impact of climate change is worsening the poverty level and food insecurity for many South Africans living in rural communities or informal settlements[4]. The increasing rate of floods and droughts recorded across the country is an indication of the negative impacts of climate change impacts. These impacts will not only affect the poor will also affect the country's ability to meet its sustainable development and socio-economic goals, such as provision of resilient infrastructure, job creation and poverty alleviation, and other basic human needs such as food, water, shelter, education amongst others. It is therefore imperative for the country to pursue an inclusive, low-carbon, climate resilient and sustainable economy to reduce the risks and impacts of climate change, and alleviate poverty for the economic prosperity of the nation. South Africa already has some blueprints in the forms of national or sectoral policies, and strategies aimed at achieving climate goals, decarbonising the economy achieving and sustainable development. However, some challenges such as inadequate resources, lack of climate finance data amongst others mitigate the of the realisation of these goals[5, 6]. For instance, the transition to

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[3] The South African Climate Finance Landscape Report (2022). Climate finance landscape in South Africa. pp. 1-77. [Online] available https://www.nbi.org.za/wp-content/uploads/2022/02/CFA-Climate-Finance-Landscape-Mapping-South-Africa-Detailed-Report.pdf [Accessed 20th April, 2024].

[4] Department of Environmental Affairs (DEA) (2018) 'South Africa's 3rd Annual Climate Change Report. DEA, Pretoria. [Online] Available at https://www.dffe.gov.za/sites/default/files/reports/SouthAfricas-3rd-climate-change-report2017.pdf [Accessed on 16th July, 2024].

[5] Country Climate Development Report (2021). South Africa: Low carbon, and climate resilient in resilient in integrating development and climate goals [Online] Available at https://brickstone.africa/climate-change-in-south-africa-ccdr/ [Accessed on 6th January, 2022].

[6] The South African Climate Finance Landscape Report (2023). A technical report prepared for the Presidential Climate Commission, pp. 1-88. [Online] available at https://pccommissionflo.imgix.net/uploads/images/PCC-SA-CLIMATE-FINANCE-LANDSCAPE.pdf [Accessed 20th April, 2024].

low-carbon, climate-resilient, inclusive, and sustainable economy as well as the implementation of the nationally determined contribution (NDC) require effective allocation of resources. Furthermore, data relating to climate finance, low carbon transition are needed to support the implementation of the national blueprints and policies, so that resources can be adequately mobilised to promote a resilient, inclusive, and sustainable economy[7]. The understanding of the climate finance strategies, including existing and potential investments will facilitate the achievement of the financial target to achieve the goal of climate finance. The United Nations (UN) 2030 Agenda for Sustainable Development goals indicate the benefits of inclusive and sustainable economy, employment and decent work for all (SDG8) and to "build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation (SDG9)[7]. Thus, sustainable development can be deployed as a pathway to achieving the Paris Agreement on a global level of reducing global warming by 1.5°C[8, 9]. Furthermore, to a achieve a climate resilient economy, there is a need to achieve energy efficiency by the restructuring the energy sector. This is due to the fact that approximately 80% of the South Africa's GHG emissions emanate the energy usage thereby increasing the vulnerability of the country to the impact of climate change[10].

The attainment of an inclusive and sustainable economy also necessitates the diversification of the economy, implementation of social and labour plans, upskilling of the workforce, creation of employment opportunities, gender

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7 Intergovernmental Panel on Climate Change (IPCC) (2019a). Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Geneva: Intergovernmental Panel on Climate Change. [Online] Available at https://www.ipcc.ch/site/assets/uploads/2019/08/Fullreport-1.pdf. /[Accessed on 4th January, 2023].

8 United Nations (UN) Report (2023). Sustainable Development Goals Report. [Online] Available at https://unstats.un.org/sdgs/report/2023/ [Accessed 1st April, 2024]

9 Intergovernmental Panel on Climate Change (IPCC) (2019b). Special report on the ocean and cryosphere in a changing climate. Geneva: Intergovernmental Panel on Climate Change. [Online] Available at https://www.ipcc.ch/site/assets/uploads /sites/3/2019/11/SROCC_FinalDraft_FullReport.pdf. /[Accessed on 4th January, 2023].

10 Cassim, A., Radmore, J-V., Dinham, N. & McCallum, S. (2021). South African climate finance landscape. [Online] Available at https://www.climatepolicyinitiative.org/wp-content/uploads/2021/01/South-African-Climate-Finance-Landscape-January-2021.pdf [Accessed on 4th January, 2023].

balance, social protection, creation of new green sectors, amongst others. Hence, the road map to an inclusive, resilient and sustainable economy in South Africa requires effective collaboration among the national and provincial governments, municipalities, civil society organisations, public and private sectors.

The pursuit of an inclusive and sustainable economy must be characterised with creation of employment opportunities, reduction of poverty and inequality while mainstreaming the driving policies into the South African policy. The major sectors driving the climate resilience in South Africa include: clean energy, low-carbon transport, clean water (supply and demand), circular economy and agriculture. South Africa's National Climate Change Response Policy indicates the need for financial organisations to provide financial services to drive the South Africa's climate and green finance projects[11]. The Biennial Update Report stressed the need for investing and financing projects geared towards the low-carbon and climate-resilient economy in South Africa[12]. The International Finance Corporation valued the sum needed by South Africa to meet her Nationally Determined Contributions as R596 billion per year totaling R8.9 trillion from 2015 to 2030 (over a 15-year span)[13]. Buchner *et al.*[14] stated that the South Africa Climate Finance landscape employs the Climate Policy Initiative (CPI) framework for climate financing. It aims to enable government and policymakers understand the trend of climate finance flows in the economy so as to map out the areas of shortfall that require more investment and improvement. This is achieved by mapping out the lifecycle of financial

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[11] National Climate Change Response Policy (NCCRP, 2011) [Online] Available at https://www.dffe.gov.za/sites/default/files/legislations/national_climatechange_response_whitepaper.pdf [Accessed: 26th July, 2024].

[12] Biennial Update Report (2021) South Africa's 4th biennial update report to the United Nations framework convention on climate change. Department of Forestry, Fisheries and the Environment. [Online] Available at https://unfccc.int/sites/default/files/resource/South%20Africa%20BUR4%20to%20the%20 UNFCCC.pdf [Accessed on 26th July, 2024].

[13] IFC (2016). Sub-Saharan Africa Climate-Smart Investment Potential. [Online] Available at: https://www.ifc.org/wps/wcm/connect/59260145-ec2e-40de-97e6-3aa78b82b3c9/3503-IFC-Climate_Investment_Opportunity-Report-Dec-FINAL.pdf?MOD=AJPERES&CVID=lBLd6Xq#page=71. [Accessed 3rd January, 2023].

[14] Buchner, B., Falconer, A., Hervé-Mignucci, M., Trabacchi, C. & Brinkman, M. (2011). The Landscape of Climate Finance. A CPI Report. (Venice: Climate Policy Initiative).

flows, from the sources through to intermediaries, including the financial instruments, disbursement channels, and the final users.

The motivation for this study stems from the global drive towards a low-carbon transition. This requires the development and implementation of new approaches to build climate resilience while promoting an inclusive and sustainable economy. Thus, the aim of this study is to investigate the impact of climate funds on some selected sectors of the South Africa's economy and to provide policy recommendations that can assist South Africa and other countries achieve an inclusive, climate resilient and sustainable economy using secondary quantitative data and specifically South Africa as a case study. Although the historical secondary data used in this study may miss some important factors, thus, leading to inaccurate analysis and forecast, bias, incompleteness, and may also become less relevance with time. However, it was ensured that recent dataset was employed to promote the relevance and applicability of this study to the phenomenon investigated. The outcome of this study will promote the stability of the South Africa economy through resilience to economic and climate stressors, and instability, while ensuring that sustainable goals targets are met. This study also provides a road map for South Africa in her pursuit of a low-carbon transition, and climate resilient economy by 2030.

The succeeding section presents the literature review, while the third section describes the methodology employed detailing the quantile regression model. The fourth section presents and explains the results obtained while the last section provides the conclusion, recommendations, limitation of the study and direction for future studies.

2. LITERATURE REVIEW

2.1 Inclusive, Resilient and Sustainable Economy Goal of South Africa

The report of the Country Climate and Development Report (CCDR) indicated that South Africa aims to achieve a more inclusive, resilient, and sustainable economy[6]. The framework to achieve these captures three major transitions that are currently pursued. These are: the "low-carbon transition", climate-resilient transition" and "just transition"[6]. The focus of the "low carbon transition" is to encourage investments in technologies and projects with the potentials to address energy needs with significant reduction in the greenhouse gas emissions. The "low carbon transition" encompasses investments in energy efficiency projects, green transportation amongst

others. The "climate-resilient transition" is aimed at investing projects that can promote the adaptation or mitigation of climate related impacts such as temperature increase, changing weather patterns, floods, drought, heatwaves etc. on people, agriculture, ecosystem and communities. Such projects include afforestation, irrigation, agronomic practices, land use management, green transportation and ecosystem restoration etc. Lastly, the "just transition" is targeted at achieving equity, poverty reduction and improvement in the socio-economic well-being of people through job creation, skills acquisition programmes and support for the small and medium scale enterprises[6]. According to CCDR a projected sum of R8.5 trillion (about $500 billion in net present value) will be needed between 2022 and 2050, and a sum of R2.4 trillion ($140 billion) would be needed before 2030 to achieve these major transitions[6]. The report of the South African Climate Finance Landscape Report also indicate that South Africa will require an average of R334 billion per year to meet its net zero goal by 2050, and an average of R535 billion per year to meet its Nationally Determined Contribution (NDC) target by 2030[7]. This necessitates public-private partnership, outsourcing of funds from external or international sources.

South Africa seeks to strike a balance between increasing production to meet the demand and enhance the quality of life while pursuing a just transition towards an inclusive and climate-resilient economy. To achieve the vision 2030 aimed at a low-carbon transition, and climate resilient economy, South Africa must reduce her dependence on coal and fossil as the main source of energy while seeking renewable and alternative means of energy generation.

2.2 The Impact of Climate Change

Climate change refers to the variation in the average temperature and weather pattern of a region or the planet over time. As experienced in other parts of the world, it poses significant threat to the South Africa's economy, ecosystem, infrastructure as well as human lives thereby hindering sustainable national development, considering the high poverty and inequalities in the

country[15]. Globally climate change constitutes a threat to human lives and livelihood as well the environment and economy[16].

The impact of climate change on the environment ranges from fluctuating weather patterns, increase global temperature, or global warming, air pollution, depletion of natural resource depletion, increased risk of extreme weather events such as flooding as well as loss of ecosystem and biodiversity[17]. Studies have linked climate change to human activities such as over dependence and use of fossil fuels as the major source of energy deforestation, indiscriminate waste disposal etc.[18, 19]. Sharma[20] as well as Ozturk and Acaravci[21] established a positive correlation between economic growth and environmental degradation. The authors found a direct relationship between gross domestic product (GDP) growth and CO_2 emissions[21, 22]. Thus, reduction in the amount of CO_2 emitted will mitigate climate change significantly[22,23].

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15 Motsoere, S. (2022). Manufacturers mood darkens after deadly South African floods. Bloomberg [Online] Available at: https://www.bloomberg.com/news/articles/2022-05-03/manufacturers-mood-darkens-after-deadly-south-african-floods [Accessed: 7th May, 2022].

16 Hambira, W.L., Saarinen, J. & Moses, O. (2020). Climate change policy in a world of uncertainty: changing environment, knowledge, and tourism in Botswana. African Geogr. Rev. 39, 252–266.

17 Gough, I. (2017). The social dimensions of climate change. In: Climate Change, Capitalism and Sustainable Wellbeing, pp. 19–37.

18 Teixeira, E. I., de Ruiter, J., Ausseil, A. G., Daigneault, A., Johnstone, P., Holmes, A., Tait, A. & Ewert, F. (2018). Adapting crop rotations to climate change in regional impact modelling assessments. Sci. Total Environ. 616, 785–795.

19 Ozcan, B., Tzeremes, P. G., Tzeremes, N. G. (2020). Energy consumption, economic growth and environmental degradation in OECD countries. Econ. Modell. 84, 203–213.

20 Sharma, S. S. (2011). Determinants of carbon dioxide emissions: Empirical evidence from 69 countries. Appl. Energy, 88, 376–382.

21 Ozturk, I. & Acaravci, A. (2013). The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. Energy Econ. 36, 262–267.

22 Kompas, T., Pham, V. H., Che, T. N. (2018). The effects of climate change on GDP by country and the global economic gains from complying with the Paris climate accord. Earth's Future, 6, 1153–1173.

23 Atsu, F. & Adams, S. (2021). Energy consumption, finance, and climate change: does policy uncertainty matter? Econ. Anal. Pol. 70, 490–501.

Acemoglu *et al.*[24] identified the use of climate-friendly technology as part of sustainable measures to curb CO_2 emissions while the need for the development and use of climate mitigation technologies should be considered[25, 26, 27].

Shahbaz *et al.*[28] stressed the importance of biomass energy consumption to reduce CO_2 emissions in the Middle East and North African countries while Adedeji *et al.*[29] suggest the need to embrace sustainable energy option to tackle air pollution and mitigate climate change. Climate change also affects the economy. For instance, besides the loss of lives and properties due to cape town flooding in 2011 over R20 million was lost to infrastructure repair[30]. According to Motsoere[16], KwaZulu-Natal (KZN) lost about R5.6 billion worth of infrastructure with significant loss in gross domestic product (GDP). According to the United Nations Environmental Programme, on a global scale, about 4.1 trillion dollars is needed to mitigate the impact of climate change and to restore biodiversity[31]. European Environment Agency

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24 Acemoglu, D., Akcigit, U., Hanley, D., Kerr & W. (2016). Transition to clean technology. J. Polit. Econ. 124, 52–104.

25 Su, H. N. & Moaniba, I. M. (2017). Does innovation respond to climate change? Empirical evidence from patents and greenhouse gas emissions. Technol. Forecast. Soc. Change, 122, 49–62.

26 Ferreira, J. J. M., Fernandes, C. I. & Ferreira, F. A. F. (2020). Technology transfer, climate change mitigation, and environmental patent impact on sustainability and economic growth: a comparison of European countries. Technol. Forecast. Soc. Change, 150, 119770.

27 Yue, L., Miao, J., Ahmad, F., Draz, M. U., Guan, H., Chandio, A. A. & Abid, N. (2022). Investigating the role of international industrial transfer and technology spillovers on industrial land production efficiency: Fresh evidence based on Directional Distance Functions for Chinese provinces. J. Clean. Prod. 340, 130814.

28 Shahbaz, M., Balsalobre-Lorente, D. & Sinha, A. (2019). Foreign direct Investment–CO2 emissions nexus in Middle East and North African countries: importance of biomass energy consumption. J. Clean. Prod. 217, 603–614.

29 Adedeji, A.R., Zaini, F., Mathew, S., Dagar, L., Petra, M. I. & De Silva, L. C. (2020). Sustainable energy towards air pollution and climate change mitigation. J. Environ. Manag. 260, 109978

30 Al-Ghadi, S. M., Mohtar, W. H. M., Razali, S. F. M. & El-Shafie, A. (2020). The practical influence of climate change on the performance of roads stormwater drainage infrastructure. J. of Engineering, 2020(8582659), 1-13.

31 United Nations Environmental Program (2021). Tripling Investments in Nature-Based Solutions by 2030. [Online] available at: https://www.unep.org/events /publication-launch/state-finance-nature-tripling-investments-nature-based-solutions-2030 [Accessed 19th June, 2024].

member nations reported that an estimated sum of EUR 446 billion was incurred in economic losses between 1980 and 2019 by the European countries[32].

In terms of health risk, Symonds *et al.*[33] as well as Valentova and Bostik[34] stated that health risk is associated with climate change. Although the advanced economies have developed and implemented climate change mitigating and adaptation measures, yet the impact is still devastating[26]. Nasir *et al.*[35] and Afrifa *et al.*[36] indicated that climate change affects economic growth directly and indirectly. For instance, increase in industrial activities may lead to economic growth in the short rum and climate change in the medium or long run[37].

Some authors found that climate change reduces socio-economic activities such as local or foreign investments, business profitability and employment opportunities in the short run, with reduction in level of productivity and GDP in the long run[38,39,40] Zheng *et al.* [41] stated the need for the

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[32] European Environment Agency (2021). Economic losses from climate-related extremes in Europe [Online] available at: https://www.eea.europa.eu/ [Accessed 12th May, 2023].

[33] Symonds, P., Milner, J., Mohajeri, N., Aplin, J., Hale, J., Lloyd, S. J. & Davies, M. (2020). A Tool for Assessing the Climate Change Mitigation and Health Impacts of Environmental Policies: The Cities Rapid Assessment Framework for Transformation (CRAFT). https://doi.org/10.12688/wellcomeopenres. No. 5).

[34] Valentova, A. & Bostik, V. (2021). Climate change and human health. Mil. Med. Sci. Lett. (Vojenske Zdr. List), 90, 93–99.

[35] Nasir, M. A., Duc Huynh, T. L., Xuan Tram, H. T. (2019). Role of financial development, economic growth & foreign direct investment in driving climate change: a case of emerging ASEAN. J. Environ. Manag. 242, 131–141.

[36] Afrifa, G. A., Tingbani, I., Yamoah, F. & Appiah, G. (2020). Innovation input, governance and climate change: evidence from emerging countries. Technol. Forecast. Soc. Change, 161, 120256

[37] Tol, R. S. (2018). The economic impacts of climate change. Rev. Environ. Econ. Pol. 12, 35–49.

[38] Rezai, A., Taylor, L. & Foley, D. (2018). Economic growth, income distribution, and climate change. Ecol. Econ. 146, 164–172.

[39] Liu, H., Lei, H. & Zhou, Y. (2022). How does green trade affect the environment? Evidence from China. J. Econ. Anal. 1, 1–19.

[40] Meng, Y., Liu, L., Xu, Z., Gong, W. & Yan, G. (2022). Research on the Heterogeneity of Green Biased Technology Progress in Chinese Industries—Decomposition Index Analysis Based on the Slacks-based measure integrating (SBM). J. Econ. Anal. 1, 17–34.

implementation of adaptation or mitigating strategies to reduce the impact of climate change on economic growth across different countries. The mitigation process starts with the identification of the nature of impacts and the development of mitigating or adaptation strategies that will minimise the identified impacts. Existing studies indicate the need for the mitigation of the impact of climate change to promote environmental sustainability[42,43] Nordhaus[44] highlighted the climate change cycle as follows: human activities such as an initial increase in economic activities that triggers CO_2 emissions, environmental degradation and health problems, reduction in economic growth, and GDP due to the negative impacts of climate change such as drought, flooding on agriculture, land and infrastructure these preceding phases are succeeded by reduction in environmental and social impacts due to the implementation of climate change mitigation efforts lower the environmental and social impact, and the cycle starts from the first phase again (Figure 1).

[41] Zheng, C., Deng, F., Zhuo, C. & Sun, W. (2022). Green credit policy, institution supply and enterprise green innovation. J. Econ. Anal. 1, 20–34.

[42] Li, M. & Wang, Q. (2017). Will technology advances alleviate climate change? Dual effects of technology change on aggregate carbon dioxide emissions. Energy Sustain. Dev. 41, 61–68.

[43] Tschora, H., Cherubini, F. (2020). Co-benefits and trade-offs of agroforestry for climate change mitigation and other sustainability goals in West Africa. Glob. Ecol. Conserv. 22, e00919.

[44] Nordhaus, W. (2019). Climate change: the ultimate challenge for economics. Am. Econ. Rev. 109, 1991–2014.

Figure 1: Climate change cycle
Source: Authors (adapted from Nordhaus[45])

2.3 Empirical Studies on the Development of a Climate Resilient Economy

Wang *et al.*[45] investigated the multiple impacts of technological progress on the emission of CO_2 in China using a panel quantile regression approach. The results obtained indicate that technological advances in heavy and light industries promote a higher level of CO_2 emissions, but with significant contribution to the improvement in energy efficiency improvement. The results further show that industries such as construction and service industries exert a negative effect on CO_2 generation. Li and Wang[43] investigated the complex relationship between technology change and carbon dioxide emissions using dual effect model. The outcome of the study indicated that technological change contributes positively to the reduction of aggregate carbon dioxide emissions, but also negatively to the scale and intensity of carbon dioxide generation.

[45] Wang, S., Zeng, J. & Liu, X. (2019). Examining the multiple impacts of technological progress on CO_2 emissions in China: a panel quantile regression approach. Renew. Sustain. Energy Rev. 103, 140–150.

Abid *et al.*[46] employed the quantile regression models to access the impact of climate change mitigation efforts on economic growth, social and environmental development in Europe. The outcome of the study revealed that climate change mitigation effort is ineffective in enhancing economic growth for countries ranked low in environmental performance, however, it was found to slightly promote economic growth and social development in countries with high or moderate environmental performance. Furthermore, a positive and significant correlation was established between climate change mitigation efforts and environmental development for all European countries Climate change mitigation promotes environmental development for all countries. The authors indicated that trade openness and choice of energy sources are important factors that promote climate change mitigation efforts.

Existing studies have employed the regression technique to investigate the factors promoting climate change and its impacts. For instance, Xu and Lin[47] employed the quantile regression model to probe the underlying factors responsible for large regional differences in particulate matter (PM2.5) in China. the outcome of the study shows that the drive for economic growth, industrialisation and urbanisation are the major contributing factors to the regional differences in particulate matter pollution in China. Xu and Lin[48] also investigated the factors driving the emission of CO_2 in China's heavy industry: a using the quantile regression technique. The outcome of the study indicated that economic growth exerts a stronger influence on the CO_2 emissions of heavy industries in the 25th-50th quantile, while urbanisation had the least impact on CO_2 emissions in the 10th-25th quantile. In the 10th-25th and 25th-50th quantile, the rate of energy consumption was found to have the highest on CO_2 emissions. Elshennawy *et al.*[49] projected that the GDP of Egypt will drop by 6.5% by the middle of this century due to the absence or non-implementation of policy on climate change mitigation measures.

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[46] Abid, N., Ahmad, F., Aftab, J. & Razzaq, A. (2023). A blessing or a burden? Assessing the impact of climate change mitigation efforts in Europe using quantile regression models. Energy Policy 178 (113589), 1-23.

[47] Xu, B. & Lin, B. (2018). What cause large regional differences in PM2.5 pollution in China? Evidence from quantile regression model. J. Clean. Prod. 174, 447–461.

[48] Xu, B. & Lin, B. (2020). Investigating drivers of CO2 emission in China's heavy industry: a quantile regression analysis. Energy, 206, 118159.

[49] Elshennawy, A., Robinson, S. & Willenbockel, D. (2016). Climate change and economic growth: an intertemporal general equilibrium analysis for Egypt. Econ. Modell. 52, 681–689.

2.4 Theoretical Frameworks on Inclusive, Climate Resilient and Sustainable Economy

This study considers some economic theories such as the neoclassical, neorealist and the inclusive economic theory. The neoclassical economic theory_argues that the production, pricing, and consumption of goods and services are a majorly driven by the forces of demand and supply[50]._In contrast to Keynesian economics, the neoclassical theory argues that the savings determine investment and that market equilibrium and growth should be the main economic priorities of government. The theory is based on three major assumptions[51]: (1) rational thinking which believes that people make rational choices between options based on the value they can benefit from each of the choices (2) utility maximisation which opines that the aim of consumers is to maximize utility (personal satisfaction), while that of business organisations is to maximise profits (3) Information: which believes that people's action is independent based on the relevant information they have to make choices. However, the critics of neoclassical economics argue that the neoclassical approach cannot accurately define the actual economies and maintain that the assumption of "rational in making choices does not consider in the vulnerability of human nature to emotional responses, resource distribution and standard of living of people.

The neo-realist economic theory_argues that the production, pricing, and consumption of goods and services are a majorly driven by the state (government) and interplay of international political forces[51,51,52]. This theory emphasizes group values on utilities such as benefits for family, organisation, community, nation and government rather than individual utility values emphasised by the neoclassical theory. The neo-realist economic theory has been criticised for the relevance of foreign policy behaviours as well as lack of consideration for domestic politics, race, trade gains, the assuaging effects of institutions[53, 53].

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50 Van Niekerk, A. (2019). A conceptual framework for inclusive economics', South African Journal of Economic and Management Sciences 22(1), a2915.

51 Milner, H. V. (2020). Interests, Institutions, and Information: Domestic Politics and International Relations. Princeton University Press, New Jersey.

52 Milner, H. V. (1991). The Assumption of Anarchy in International Relations Theory: A Critique. Review of International Studies. 17 (1), 67–85.

53 Rosefielde, S. & Pfouts, R. (2015). Inclusive economic theory, World Scientific, Hackensack, New Jersey.

The inclusive economy theory aims to address the limitations of the neo-classical and neo-realist economic theories and serves as umbrella that provides useful insights into how individual, societal and national values (well-being) can be achieved. The value or well-being is determined as a composite of individual and societal outcomes that is evaluated via different normative observations[53]. The theory stressed the involvement of people and government in ensuring equitable distribution and access to wealth, employment resources, goods and services etc. for the socio-economic wellbeing of individuals, society and nation.

This study also explores the climate resilience theory which explains the process of mitigating and adapting to climate related challenges. The theory identifies the capacity to adapt, anticipate and absorb extreme climate conditions and disasters as important factors of climate resilience[54]. There is a link among factors such as vulnerability, risk, and resilience such that the vulnerability concept and risk can be used as variables for the development climate resilience framework[55]. Other factors include: exposure level, sensitivity, potential impact, hazard, as well as the capacity to mitigate and adapt to adverse conditions. In South Africa, efforts such as policy formulation and implementation, deployment of resources etc. have been committed to various critical sectors etc. to mitigate climate change, however, the quantification of the impact of the efforts across the various sectors has not been sufficiently highlighted by the literature. This is a major area of focus in this study with a view to providing policy recommendations that can assist South Africa and other countries achieve an inclusive, climate resilient and sustainable economy.

From the literature reviewed, there is a dearth of information regarding the analysis and quantification of the efforts geared towards climate change mitigation according to the various sector in South Africa. Thus, this study contributes theoretically and empirically to knowledge om climate change mitigation efforts in South Africa. The novelty of this study lies in the use of the quantile regression model for the investigation of the impact of climate funds on some selected sectors of the South Africa's economy. The next

[54] Kammouh, O., Dervishaj, G., Cimellaro, G. P. (2017). A new resilience rating system for Countries and State. Procedia Engineering, 198, 985-998

[55] Subiyanto, A., Boer, R., Aldrian, E., Perdinan, Kinseng, R. (2020). Climate resilience: Concepts, theory and methods of measuring. EnvironmentAsia 13(1), 1-13.

section (methodology) details on the data employed and the application of the quantile regression model.

3. METHODOLOGY

Figure 2 presents the research approach followed in this study. The aim of this study is to investigate the impact of climate funds on some selected sectors of the South Africa's economy. These sectors include: water conservation, supply and demand (WCSD), agriculture, forestry, fisheries and land use (AFOLU), low carbon transport (LCT), circular economy (CEC), general ecosystem support (GES), energy efficiency and demand side management (EE & DSM), clean energy (CE), cross sectoral projects (CSP). Figure 3 expresses the relationship between climate fund and these sectors.

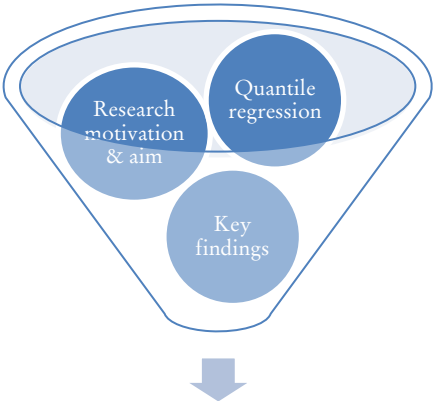

Figure 2: Research approach
Source: Authors

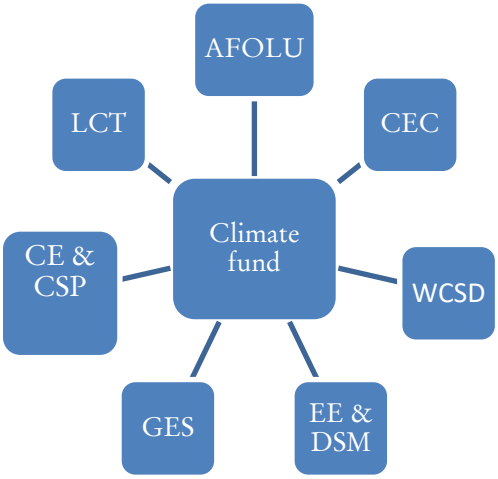

Figure 3: Relationship between climate fund and the beneficiary sectors.
Source: Authors'

3.1 Data Employed

This study employs secondary quantitative data obtained from the South African Climate Finance Landscape Report[4,7]. Secondary data is cost and time effective while quantitative data set boasts of objectivity, reliability and can lead to a generalizable outcome. Table 1 presents the details of the financial flows in the South African climate finance landscape comprising of the public, private and blended finance flows totalling R63 billion and 131 billion from 2017-2018 and 2019-2021 respectively.

Table 1: Average annual tracked investment 2017-2021

Sector	Average amount invested (Rands)	Average amount invested (Rands)	Difference (Rands)
Water conservation, supply and demand	1.87 b	5 b	+3.13 b
Agriculture, forestry, fisheries and land use (AFOULU)	1.87 b	17 b	+15.13 b
Low carbon transport	2.48 b	87 m	−2.40 b
Buildings and the built environment	-	2 b	
Circular economy	1.24 b	244 m	966 m
General ecosystem support	3.73 b	665 m	−3.07 b
Energy efficiency and demand side management (EE & DSM)	1.24 b	21 b	19.76 b
Clean energy	47.2 b	82 b	+39.07 b
Others and cross sectoral projects	3.11 b	3 b	−110 m
Material substitution	6.22 m	-	
Total climate fund	63 b	131 b	

Source: South African Climate Finance Landscape Report[4,7]

3.2 The Quantile Regression Model

This study employed the quantile regression model to the relationship between the climate fund disbursed to mitigate the effects of climate change and its impact on critical beneficiary sectors namely: water conservation, supply and demand, agriculture, forestry, fisheries and land use, low carbon transport, circular economy, general ecosystem support, energy efficiency and demand side management, clean energy, and cross sectoral projects. The quantile regression model was proposed by Koenker and Bassett to address the limitations of the ordinary least squares[56].

It is a statistical technique used in this study to understand the relationship between the specific quantile of a dependent variable (climate fund) and the

[56] Koenker, R. & Bassett, G. (1978). Regression quantiles. Econometrica, 46, 33–50.

independent or predictor variables (beneficiary sectors) and dependent variable (climate fund). Compared to the linear regression model, it estimates the mean of the dependent variable and its distribution at different quantiles[57]. The quantile regression analysis was implemented in the Statistical Package for Social Science (SPSS, 2020 environment). To ensure the accuracy of the regression analyses, it was ensured that the dataset employed is fairly sufficient for multiple regression analysis and that the dependent variable is a quantitative data measured on a continuous scale.

The independent variables (beneficiary sectors) are grouped into eight categories namely: water conservation, supply and demand, agriculture, forestry, fisheries and land use, low carbon transport, circular economy, general ecosystem support, energy efficiency and demand side management, clean energy, cross sectoral projects. The impact of the funding provided for these sectors largely determines the achievement of the South Africa's vision 2030 and reflects the progress made in the sector geared towards economic and environmental development. To investigate the impact of the climate funds allocated to these sectors in South Africa data set from the South African Climate Finance Landscape Report from 2017 to 2021 was employed[4,7].

Existing studies have demonstrated the suitability of the quantile regression models for economic related analysis[45, 58] environmental studies, and for the estimation of the coefficient values at the extreme of distribution[59]. Abid *et al.*[47] stated that the quantile regression is an alternative regression approach to the linear regression models as it estimates the quantile (conditional median distribution) of the dependent variable and accounts for hidden heterogeneity and heterogeneous covariate effects in the dataset.

The standard linear regression is limited in applicability in that it can only evaluate the conditional mean of the dependent variable without providing holistic information about the conditional distribution[47]. Furthermore, in the standard linear regression analysis, the error term is considered as an

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[57] Khan, H., Khan, I. & Binh, T. T. (2020). The heterogeneity of renewable energy consumption, carbon emission and financial development in the globe: a panel quantile regression approach. Energy Rep. 6, 859–867.

[58] Canay, I. A. (2011). A simple approach to quantile regression for panel data. Econom. J. 14, 368–386.

[59] Cheng, F., Yang, S., Zhou, K. (2020). Quantile partial adjustment model with application to predicting energy demand in China. Energy, 191, 116519.

independent value of the variables, with homogeneity of the variances across the dataset, whereas, in quantile regression models, there is variation of the error term. Hence, the quantile regression approach provides a more accurate impact analysis compared to the standard linear regression technique. The optimal estimation of the conditional estimates, allows the visualisation of the range of the conditional variability[60].

Thus, the choice of the quantile regression model in this study is informed by its suitability to provide an estimate of the conditional median distribution when the impact of parameters varies across different conditional quantiles in order to determine the regression coefficient based on quantiles[61]. It is more robust for the analysis of outliers and heavy distribution compared to the standard linear regression technique although the estimation of the variables and their interpretation may be challenging depending on the expertise of the analyst[62].

Equations 1 and 2 present the general form of the quantile regression model[47].

$$y_i = x_i\beta_0 + U_{\theta 1} 0 < \theta < 1 \quad (1)$$

$$\mathrm{QR}_\theta(y_i|x_i) = x_i\beta_0 \quad (2)$$

Where:

y_i is the dependent variable, x_i is the vector of the independent variables, U is the random error the that fulfils the homoscedastic constraint having a conditional quantile distribution that is equal to zero, while β_0 represents the θth quantile regression estimator, and $\mathrm{QR}_\theta(y_i|x_i)$ represents the θth quantile of the dependent variable.

The solution of the quantile regression model is represented by equation 3[46].

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60 Koenker, R. (2004). Quantile regression for longitudinal data. J. Multivariate Anal., 91, 74–89.

61 Arshad, M., Amjath-Babu, T.S., Aravindakshan, S., Krupnik, T.J., Toussaint, V., K., Achele, H., & Müller, K. (2018). Climatic variability and thermal stress in Pakistan's rice and wheat systems: a stochastic frontier and quantile regression analysis of economic efficiency. Ecol. Indicat. 89, 496–506.

62 Waldmann, E. (2018). Quantile regression: a short story on how and why. Stat. Model. Int. J. 18, 203–218.

$$(y_i|x_i) = min \sum_{i \geq x_i\beta} \boldsymbol{\theta}|\, y_i - \, x_i\beta| + \sum_{i \geq x_i\beta} (1-0)|\, y_i - y_i - \, x_i\beta \quad (3)$$

Different quantile representations namely 10th, 25th, 50th, 75th, and 95th quantiles were selected for use in this study so as to obtain the regression model results for all quantile points[49]. The variation of the values of θ during quantile analysis assists in obtaining different parameter estimates of the phenomenon being investigated. Thus, to investigate the impact of climate change funds on the beneficiary sectors, the different quantile representations were selected to achieve optimal outcomes.

4. RESULTS AND DISCUSSION

Figure 4 shows the financial investment made into the respective sectors from 2017-2018 and 2019-2021. The figure shows that clean energy remains a top priority of the South African government, followed by energy efficiency and demand side management, and thirdly agriculture, forestry, fisheries and land use with significant increase in the investment made from 2019-2021 compared to 2017-2018. There was significant reduction in the financial commitments made towards sectors such as low carbon transport, circular economy, general ecosystem support from 2019-2021 compared to 2017-2018.

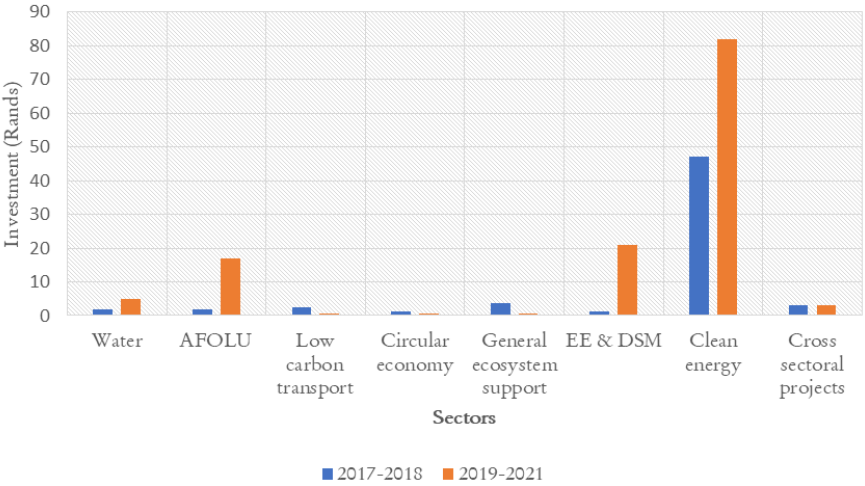

Figure 4: Financial investment made into the respective sectors from 2017-2018 and 2019-2021.

Table 2 presents the summary of the descriptive statistics of the dependent and independent variables. The dependent variable (climate funding) has a mean value of 74.6667 dispersed between a minimum value of 90.00 and maximum value of 131.00 with a standard error of 29.73401, standard deviation of 51.50081 and variance of 2652.333. The mean represents the average of dataset thus high implies that significant effort is made in providing funding for mitigating the impact of climate change, however, the efforts fluctuate as indicated by high values of the standard error, standard deviation and variance. This mean that significant effort is still required to achieve stability in the acquisition of climate funds for climate change mitigation in the South Africa. Similarly, high mean values and high values of the standard error, standard deviation and variance were observed for independent variables such as water conservation, supply and demand, agriculture, forestry, fisheries and land use, energy efficiency and demand side management, clean energy, and cross sectoral projects. This implies that significant but unstable efforts are committed to these variables in relation to the mitigation of the effect of climate change. For variables such as low carbon transport, circular economy and general ecosystem support, their respective means were relatively low indicating that the investment committed into these variables are relatively low. The descriptive statistics provided useful insights that aid the understanding of the level of efforts

committed into the acquisition of the climate funding as well as the level of investment committed to the various sectors.

Table 2: Descriptive statistics of the dependent and independent variables

Variable	Descriptive statistics					
	Minimum	Maximum	Mean	Standard error	Standard deviation	Variance
Water	1.10	5.00	2.6567	1.19256	2.06558	4.267
AFOLU	1.00	17.00	6.6233	5.19441	8.99698	80.946
Low caron transport	0.09	2.48	1.0557	0.72740	1.25990	1.587
Circular economy	0.20	1.24	0.5613	0.33957	0.58815	0.346
General ecosystem support	0.25	3.73	1.5483	1.09739	1.90074	3.613
Energy efficiency and demand side management	0.33	21.00	7.5233	6.74345	11.68000	136.422
Cross sectoral projects	0.34	3.11	2.1500	0.90556	1.56847	2.460
Clean energy	22.00	82.00	50.4000	17.39425	30.12773	907.680
Climate fund	90.00	131.00	74.6667	29.73401	51.50081	2652.333

Table 3 presents the cross-sectional dependence of the variables and the null hypothesis which indicates that there is no cross-sectional dependence among the variables is rejected at 5% significance level because the p values of the variables were less than 0.05 ($p < 0.05$). The unit root tests comprising of the Cross-Section Augmented Dickey-Fuller (CADF) and the cross-sectionally

Augmented Im-Pesaran-Shin (CIPS) was used to further test the assumption of independence of variables[63].

The outcome presented in Table 4 indicates that the variables possess stationary properties at 5% significance level thus, the null hypothesis that suggests the existence of non-stationarity properties of the variables is rejected. The outcome of the cointegration test presented in Table 5 also led to the rejection of the null hypothesis that suggest that there is no cointegration among the variables confirms. Thus, there is evidence that supports the fact that a long-term relationship exists between climate change funding and the beneficiary sectors with respect to the mitigation of the impact of climate change. This impact or relationship is further investigated using the quantile regression (10th – 90th quantiles) and the results obtained are presented in Tables 6.

Table 3: The cross-sectional dependence of the variables

Variables	Cross sectional dependence	p-value	Correlation
Water	22.786	0.00	0.667
AFOLU	40.782	0.00	0.680
Low carbon transport	12.578	0.01	0.755
Circular economy	10.567	0.01	0.800
General ecosystem support	32.001	0.00	0.761
Energy efficiency and demand side management	45.344	0.00	0.678
Cross sectoral projects	35.776	0.00	0.600
Clean energy	28.902	0.00	0.720
Climate fund	48.445	0.00	0.580

Table 4: The CIPS and CADF values

Variables	CIPS	CADF
Water	-1.23	-1.30
AFOLU	-1.45	-1.02
Low carbon transport	-0.75	-0.56
Circular economy	-0.22	-0.35

[63] Westerlund, J., Hosseinkouchack, M. & Solerger, M. (2016). The local power of the CADF and CIPS panel unit root tests. Econometric reviews, 35(5), 845-870.

General ecosystem support	-1.46	-1.60
Energy efficiency and demand side management	-0.98	-1.71
Cross sectoral projects	-1.34	-1.23
Clean energy	-2.01	-2.45
Climate fund	-2.24	-2.09
Pesaran	-2.86	-2.78
CIPS	-2.95	-2.69

Table 5: the results of the cointegration test

Type of statistics	Type of test	Statistics 1	p-value	Statistics 2	p-value	Remarks
Group statistics	G_τ	-4.234	0.000	-4.008	0.000	Co-integration exists
	G_a	-6.490	0.000	-6.225	0.000	Co-integration exists
Panel statistics	P_f	-12.680	0.000	-8.096	0.000	Co-integration exists
	P_a	-18.227	0.000	-8.332	0.000	Co-integration exists

Table 6 presents the results obtained from the quantile regression model. The results show that the impact of climate funding on the various sectors varies at the different quantile levels. For instance, the impact of funding on sectors such as low carbon transport, circular economy and general ecosystem support is ineffective in mitigating the effect of climate change for all quartiles (q1-q5). This outcome is justified with the coefficient values of coefficient values of low carbon transport, circular economy and general ecosystem support being negative at the lower and middle quantiles (q1, q2, and q3). Low carbon transport has coefficient values of −0.235, −0.156, −1.164, -1.453 and -1.234 at q1, q2, q3, q4 and q5 respectively, while circular economy has coefficient values of −0.324, −0.118, −1.470, -1.597 and -1.532 at q1, q2, q3, q4 and q5 respectively and general ecosystem support has − 0.495, − 0.0230, − 0.0312, -0.789 respectively at q1, q2, q3, q4 and q5 respectively. This may be due to the fact that these sectors are emerging and innovative sectors with potential risks of investment that may require time, adequate policy planning and implementation for its full emergence[7, 11]. However, the low carbon transport, circular economy and general ecosystem support sectors have shown evidence of being considered investable in the near future.

Conversely, the results in Table 6 also show that the impact of funding on other sectors such as water conservation, supply and demand, agriculture, forestry, fisheries and land use, energy efficiency and demand side management, clean energy, and cross sectoral projects is effective in mitigating the effect of climate change as justified by their coefficient values being positive at the lower, middle and upper quantiles (q1, q2, q3, q4 and q5). Thus, for the period investigated, the provision of funding for sectors such as water conservation, supply and demand, agriculture, forestry, fisheries and land use, energy efficiency and demand side management, clean energy, and cross sectoral projects prove to a significant driver for sustainable development and mitigation of the effects of climate change in South Africa. The impact of funding on the various sectors was observed to be more significant in the 95th quantile followed by the 75th.

Table 6: The results of the quantile regression

Variables	q1 (10th)	q2 (25th)	q3 (50th)	q4 (75th)	q5 (95th)
Water	0.278	0.211	0.342	0.535	0.564
AFOLU	0.412	0.419	0.457	0.628	0.632
Low carbon transport	−0.235	−0.156	−1.164	-1.453	-1.234
Circular economy	−0.324	−0.118	−1.470	-1.597	-1.532
General ecosystem support	− 0.495	− 0.0230	− 0.031	-0.998	-0.789
Energy efficiency and demand side management	0.376	0.347	0.278	0.521	0.834
Cross sectoral projects	0.267	0.231	0.460	0.636	0.735
Clean energy	0.347	0.370	0.235	0.509	0.462
Climate fund	0.476	0.409	0.487	0.777	0.673

The results obtained indicate that meagre investment is in some critical sectors such as low carbon transport, circular economy and general ecosystem support sectors. Globally, there is an increase in the momentum for low-carbon transport driven primarily driven by the national commitments to reduce carbon emission generation in line with the Paris Agreement[9, 10]. According to GreenCape, South Africa is gradually developing policies, subsidies and incentives to promote low carbon transport

such as the development of the electric vehicles market[64, 65]. Thus, South Africa still lags behind in the ranks of countries with consistent increase in the manufacturing and use of electric vehicles, development of the ecosystem and value chain for electric vehicles. According to the South African Climate Finance Landscape Report, the low carbon transport sector is entitled to a higher budget, being one of the country's long-term visions, however, South Africa currently has a robust automotive market that deals with the assembly of internal combustion engine vehicles[4].

The automotive sector plays key role in the country's economic development contributing 6.4% of the country's GDP and 27.6% of the total manufacturing output with a total revenue of over ZAR 500 billion (US$ 35.6 billion) in 2019, and having employment capacity for 900,000 people either directly and indirectly across the downstream in wholesale, retail trade and maintenance. Thus, losing this sector to the vision of low carbon transport may cripple the South African economy; therefore, South Africa is pursuing a smooth and gradually transitional approach to the low carbon transport sector. This however requires more financial support as well as research and development initiatives to promote sectors such as the low carbon transport, circular economy and general ecosystem support.

For the electric vehicles market to thrive in South Africa, localisation will play a supportive role. Hence, there are significant environmental, socio-economic opportunities for South Africa in the areas of green energy transition and transition into a low-carbon economy. The South Africa's climate targets set for the automotive sector by 2030 cannot be achieved without the use of the electric vehicles into the transport system and the reductio in the use of the internal combustion engine. Modifications or improvements in the internal combustion engine might not sufficiently propel the country to the actualisation of the vision 2030 South African Climate Finance Landscape Report[3]. Apart from the low carbon transport sector, another sector that witnessed meagre investment is the circular economy sector. This sector advocates for efficient waste management via innovations or interventions that focus on reduction in waste generation, waste reuse, refurbishment, repair or recycling, reduction in landfills, energy generation from waste through biogas or biomass etc. however, the sector is

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64 GreenCape. 2020. Energy Services. [Online] Available at: https://www.greencape .coza/ market-intelligence/. [Accessed 12 May, 2023].

65 GreenCape. 2020. Utility-scale renewable energy. [Online] Available at: https:// www.greencape.co.za/market-intelligence/. [Accessed 12 May, 2023].

still predominantly reliant on the support of philanthropists, bilateral development partners and local government departments or agencies for funding due to little funding commitment from the government South African Climate Finance Landscape Report[4,7].Although clean energy sector remained a dominant sector with significant climate funding, other sectors such as water, AFOLU and energy efficiency and demand side management also saw an increase in the investments for the periods investigated in this study due to effective policy planning and implementation. Senyolo *et al.*[66] indicate that the integration of innovative concepts into the South Africa agricultural sector can make the sector smarter and more resilient to the effect of climate change.

5. SUMMARY OF FINDINGS

The findings reveal that the effects of climate finance vary significantly across quantile levels, underscoring the need for deliberate policy interventions. For instance, the impact of funding on sectors such as low carbon transport, circular economy and general ecosystem support is ineffective in mitigating the effect of climate change for all quartiles (q1-q5). Conversely, the impact of funding on other sectors such as water conservation, supply and demand, agriculture, forestry, fisheries and land use, energy efficiency and demand side management, clean energy, and cross sectoral projects are effective in mitigating the effect of climate change for the lower, middle and upper quantiles.

6. CONCLUSION AND POLICY RECOMMENDATIONS

This study investigated the impact of climate funds on some selected sectors of the South Africa's economy using secondary quantitative data obtained from the South African Climate Finance Landscape Report and the quantile regression model implemented in the Statistical Package for Social Sciences (SPSS) 2022 environment. There still exist a mismatch in finance of the critical sectors as evidenced in the findings of this study and there is a need to achieve significant balance in the funding of the critical sectors in order to achieve

[66] Senyolo, M. P., Long, T.B., Blok, V. & Omta, O. (2018). How the characteristics of innovations impact their adoption: an exploration of climate-smart agricultural innovations in South Africa. J. Clean. Prod. 172, 3825–3840.

sustainable development goals and vision 2030. This will promote an inclusive and climate resilient economy that will enhance the country's capacity to meet its development and socio-economic goals, including gender balance, poverty alleviation and job creation. The investment in low-carbon economy will reduce the impacts and risks of climate change, and improve the overall standard of living and well-being of the citizens.

This study contributes to the growing body of literature on climate finance and offers evidence-based recommendations to support South Africa and other countries in Africa in achieving an inclusive, climate-resilient, and sustainable economy.

Thus, the following are the policy recommendations that can assist South Africa achieve an inclusive, climate resilient and sustainable economy.

1. There is a need to clearly define the scope of climate finance, with its guidelines to enable effective investment and tracking of investments, performance measurement, monitoring and disclosure. The provision of provide technical guidelines and standards will help in the identification, monitoring and mitigating climate related risks.
2. For a successfully transition into a low carbon economy, the institutional investors in South Africa should be mandated to include and implement policies on financial stability and sustainability in the long run. Environmental impact assessment should also form part of the investment policies, procedures and targets for public and private sector. Thus, climate change policies should be mainstreamed and institutionalised. The integration of climate change factors into institution's goals and processes is needful.
3. There is a need to improve public-private collaborations within and outside South Africa. This calls for unity in South Africa towards climate change investments.
4. The climate financial instruments deployed should be designed with minimal barriers and risks to attract more investments into the critical sectors. There is a need to streamline policies and ensure clarity and consistency of regulations. The regulation and legislation should focus more on the creation of enabling environment for climate finance and support the just transition agenda.
5. There is a need for the creation of more incentives to increase climate financing at all sectors.
6. South African financial institutions must align with the relevant Sustainable Development Goals (SDGs) in the provision of credit facilities.

7. The level of awareness should be raised at all levels to increase the understanding of people and the stakeholder on climate financing and the impact of climate change.
8. Finally, the world is driven by data technology, the acquisition and effective management of data, relating to climate change will aid better understanding of the gaps and potentials in achieving climate goals.

This study is limited to the use of secondary quantitative data. The historical secondary data used in may miss some important factors, thus, leading to inaccurate analysis and forecast. It may also be subject to bias, incompleteness, and may also become less relevance with time. Hence future studies may consider the use of primary data set for the investigation of the impact of climate funds on some selected sectors of the South Africa's economy.