The Contribution of Taxes on Climate Change Management.
A Case of Rwanda Revenue Authority (RRA) and Rwanda Environment Management Authority (Rema)

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ABSTRACT
The aim of this study is to examine the impact of value-added taxes (VAT) and income taxes on Rwanda's climate change management. Primary data gathered from 150 employees of the Rwanda Revenue Authority and the Rwanda Environment Management Authority is used in the study. Participant representation is guaranteed to be diverse thanks to the demographic analysis. The application of VAT has a beneficial effect on Rwanda's management of climate change, according to statistical study. The statement "The implementation of Value Added Taxes positively contributes to climate change management in Rwanda" had the highest mean score of 4.87. The model built from the data that incorporates income taxes and VAT as predictors fits the dependent variable (NO_2) reasonably well, according to the regression analysis's results (R = 0.827, R Square = 0.684). With an adjusted R Square of 0.474, the model appears to be well-fitting data. The combined impact of income taxes and VAT, however, does not appear to be a major factor in explaining the difference in NO_2 levels, according to the ANOVA results. Both the income tax (p = 0.200) and the VAT (p = 0.448) have p-values over the conventional 0.05 cutoff, suggesting that these taxes may not be important factors influencing the levels of NO_2 in the context of climate change management in Rwanda.
Keywords: Climate Change Management, Taxes, Rwanda Revenue Authority (RRA), Rwanda Environment Management Authority (REMA)

I. INTRODUCTION TO THE STUDY
Taxes play a significant role in addressing climate change on a global level. Taxes also play a crucial role in addressing climate change in the Worldwide view.A report from the Organization for Economic Cooperation and Development (OECD) says that environmental taxes can help countries meet their climate goals and get more money for green investments.

The International Monetary Fund (IMF) says that taxes can be a good way to encourage people to do things that are good for the environment and to lessen the effects of climate change. Taxes can help make a better future for everyone by making it easier to use green technologies and encouraging people to do things that are good for the environment (European Commission, 2021).

In 2019, the government of Nigeria put a tax on luxury goods, including carbonated drinks. This was done to cut down on the use of sugary drinks, which hurt the environment. Many countries in Africa have put in place environmental taxes to encourage sustainable development and fight climate change. For instance, Kenya introduced a plastic bag ban and a tax on plastic bags in 2017, which have since reduced plastic bag usage by 80% (Sauda, L., 2023).

A carbon tax has also been put in place to encourage businesses to cut down on their carbon emissions. Because of these steps, Rwanda has cut down on plastic waste and carbon emissions by a lot (Cho, 2018).

In order to achieve these goals, the Ministry of Environment is responsible for designing and monitoring national climate policies (LSE, 2019).The Rwanda Environment Management Authority (REMA), which operates within this ministry is responsible for climate policy implementation through its Department of

Climate Change and International Obligations. To reach its adaptation goals, Rwanda is working towards an integrated to support cross-cutting national policies and strategies to mainstream environmental sustainability and climate change adaptation efforts. Continued adaptation efforts are focused on the country's most vulnerable sectors: agriculture, forestry, water resources, and health, and on increasing the country's resilience capabilities, and strengthen the country's social and economic structures against vulnerability (Republic of Rwanda, 2020).

Therefore, the research problem statement is to examine the role of taxes in addressing climate change and identify the factors that determine their effectiveness. Clarice, Alex, & Joseph (2023) assessed the carbon taxes and Climate-Resilient Agricultural Practices in Kenya. Yamazaki, A. (2017) find out tax reforms and behavioral economics: Lessons learned from the carbon tax in British Columbia. Studies have focused on the effectiveness of carbon taxes in reducing emissions, but there is a lack of research on other types of taxes, such as energy taxes, value added tax, corporate income tax and their impact on climate change. Secondly, there is a need for more empirical studies that examine the actual impact of taxes on emissions reduction, as opposed to only modeling studies. Finally, there is a need for research that considers the political economy of taxes and their implementation, as well as the distributional implications of different tax policies.

Addressing these gaps will help to provide a more nuanced understanding of the role of taxes in mitigating climate change, which can inform policy decisions and contribute to the broader academic literature on environmental economics. Nevertheless, no specific study concentrated on the contribution of taxes in climate change management in Rwanda. In this regard, the present research will seek to bridge information gaps.

This study aims at addressing the following objectives:
   i.   To assess effect of Value added taxes on climate change management in Rwanda.
   ii.   To find out the effect of income taxes on climate change management in Rwanda.

II. RELATED WORKS

This section reviews existing literature on the variables of this study. Literature review for this study is presented as follows.

Harelimana (2018) studied the role of taxation on resilient economy and development of Rwanda was carried out under the period 2013-2016. The main objective of the study was to assess the role of taxation on economic development. The Methodology such as qualitative and quantitative was used in data collection where both primary and secondary data were collected. A questionnaire was designed to 90 sample sizes out of 920 total employees of RRA purposively selected and a documentary technique was used. After collection, data were analyzed using SPSS where a correlation coefficient was determined to measure the relationship between variables. Based on the correlation coefficient r=0.790, we concluded that there is a significant relationship between taxation and Rwanda economic development. Thus 62% of Rwandan economic development should be addressed to taxation for enhancement purposes. It is in this regard RRA should develop goods description standards manual for verification purpose and data analysis and carry out door to door field visits to identify potential traders to be registered.

Cai, Y.(2020),in his study titled the Economic Impacts of Carbon Pricing: Evidence from a CGE Model, the researchers employ a computable general equilibrium (CGE) model to evaluate the economic and environmental consequences of carbon pricing policies. The study focuses on assessing the efficiency and distributional implications of carbon taxes while analyzing their effects on emissions reduction and overall economic performance. By utilizing the CGE model, the research provides a comprehensive understanding of the complex interactions between carbon pricing and various economic sectors. It examines how carbon taxes influence factors such as consumer behavior, investment decisions, and resource allocation within the economy. Additionally, the study investigates the potential impacts of carbon pricing on income distribution and social welfare, shedding light on the equitable aspects of such policies. Through their analysis, the researchers contribute valuable insights into the trade-offs and potential synergies between environmental sustainability and economic prosperity. The study's findings contribute to the existing knowledge by informing policymakers and stakeholders about the potential impacts of carbon pricing on emissions reduction targets and economic indicators.

Uyar et al. (2021) investigated the potential moderating influence of ICTs on the link between the digitization of government services and tax evasion. There are total of 1677 country year observations in the study's sample, which spans the years 2006-2017. Fixed effect analysis shows that the six proxies for governments' long-

term vision and the digitalization of government services both contribute significantly to reducing tax evasion. E-participation (0.012, p=0.05), future orientation (0.23, p=0.01), government adaptability (0.15, p=0.01), government Resp Change (0.15, p=0.01), Legal Framework (0.17, p=0.01), and government vision (0.082, p=0.01) were all significantly related. In addition, the adoption of ICT by society and citizens positively moderates the association between the digitalization of government services and tax evasion, such the digitalization of government services has a more significant impact on reducing evasion in countries where ICT adoption is higher. The research has a number of implications for using ICT to improve public service delivery, which might help government collect more tax money by discouraging tax avoidance.

Sadress and Juma (2018) examined the mediating effect of adoption of electronic tax system in the relationship between attitude towards electronic tax system and tax compliance using evidence from small business enterprises (SBEs) of an African developing economy. This study used a quantitative research approach where questionnaires with close-ended questions were used. This study's research design was cross-sectional and correlational. Usable questionnaires were received from 214 managers of SBEs, and data were analysed with the help of SPSS v22 and MedGraph program (Excel version). Adoption of electronic tax system is a partial mediator in the association between attitude towards electronic tax system and tax compliance. Results further indicate that adoption of electronic tax system and attitude towards electronic tax system are significantly associated with tax compliance.

Kamana (2016) assessed the influence of electronic tax management system on effectiveness of tax collection in Rwanda. The population size is 120 and 75% of respondents were interviewed. Both primary and secondary sources with their relevant tools like questionnaire and documentary analysis in order to come up with required data. The system managed to raise tax collection drastically in 2012 and 2013 by 48.1% and 42.9% respectively though still they were unable to meet the target. This was believed to be due to lack of awareness among the tax payers about electronic tax management system in place and lack of skills especially among the tax payers on how to use the system. In 2014 tax collection was increased to 888.2 against the budget which was 773.9. This implies that the RRA managed to collect revenue above the budget line by 12.6%. Consequently in 2015 revenue collection was about the budget by 98.1%. This implies that like stated in the hypothesis especially EBM and mobile payment system has relationship with revenue collection although internet system small relationship. Therefore, it can be summarized that electronic tax management system has improved tax collection in Rwanda.

Metcalf and Weisbach (2012) conducted a study on the Role of Carbon Taxes in Climate Change Mitigation, the focus is on evaluating the effectiveness of carbon taxes in mitigating greenhouse gas emissions. The researchers delve into the effects of carbon taxes on energy consumption, technology adoption, and overall environmental outcomes. Through their analysis, the study offers valuable insights into the significance of taxes in climate change management efforts. By examining the impacts of carbon taxes, the research provides a comprehensive understanding of how these policies can contribute to reducing emissions. The study sheds light on the relationship between carbon taxes and energy consumption patterns, highlighting their potential to influence consumer behavior and encourage more sustainable practices.

Research gap
In terms of geographical gaps, the majority of highlighted studies were all done outside Rwanda. For this study, it will be done in City of Kigali. In term of time gap, the latest study was carried out in 2021, yet this study is carried out in 2023. Therefore, it will bridge a time gap of two years. Concerning content, considering the highlighted studies, none was covering both the taxes and climate change management as their variable under study. Basing on these gaps, they were the motivation for this study as the researcher sought to bridge the gaps.

III. METHODOLOGIES
Study Design
Study design involves creating an outline, plan, or strategy for tackling a research question. Due to the nature of the topic, the researcher used both quantitative research method. Quantitative research is a research strategy that focuses on quantifying the collection and analysis of data. The quantitative research mainly consists of numbers and statistics. It includes method, which is predominantly used as a synonym for any data collection technique (such as a questionnaire) or data analysis procedure, such as: graphs or statistics that generates or uses numerical data (Bhat, 2022).This method was used to study relationships between factors, which are measured and recorded

as research variables.

Study population

According to Kara (2012), a population is a universe or a sum total of all units of analysis. Population is the total number of items in a specified of inquiry and researcher added that population is an asset of cases about which one wishes to draw some conclusions. The study population, a number of 100 RRA's employees from customs, reinforcement, information and technology, tax payer services, and training department and then 50 employees of REMA as presented in both tables below.

Table 1 – Population of the study from Rwanda Revenue Authority

Population category	Population size
Customs department	50
Reinforcement department	15
Information and technology department	10
Tax payer services department	15
Training department	10
Total	**100**

On the other hand, the following are the population of REMA.

Table 2 – Population of the study from Rwanda Environment Management Authority

Population category	Population size
Management department	10
Environmental compliance and enforcement	10
Environment analytics	10
Advocacy and multilateral environment agreement	10
Administration and finance	10
Total	**50**

Sampling and sample size

As the population of interest is small, it is often feasible to conduct a census rather than a sample-based approach. The census method is a research technique used to collect data from an entire population rather than a sample. It involves collecting data from every member of the population of interest, rather than a smaller subset.

Data Analysis

The collected data was thoroughly analysed using both descriptive and inferential statistical approaches. The descriptive statistics were used to create a concise and accurate description of the data's key features. This included calculating metrics such as means to establish average values, frequencies to emphasise response frequencies, percentages to show categorical data distributions, and standard deviations to show the spread of data points around the mean. These statistical tools gave a concise and clear comprehension of the dataset, allowing it to be easier to discover trends and central tendencies among the variables under consideration.

- **Mean**

The mean refers to the average value of a set of numbers, which is obtained by dividing the sum of the numbers by the total count.

$$\bar{X} = (x_1 + x_2 + x_3 + \dots + x_n)/n$$

Where, the mean is typically represented by the symbol '$\bar{x}$', which is a bar placed above the letter x. This bar indicates the average of a set of values for x.

In this study, the mean is evaluated through categories where we rank them from 1 to 5 labels as "Strongly disagree" to "Strongly agree" depending to the appreciation of the respondents toward the given statement.

- **Standard deviation**

The Standard Deviation is a measure that shows how much variance there is from the mean. It represents the average deviation from the mean and is widely used to quantify variability because it reverts to the data set's original units of measurement.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Where, s = Sample standard deviation, n = Number of observations in sample, xi = ith observation in the sample, x̄ = Sample mean.

Inferential statistics were used in the study to improve comprehension and forecast outcomes based on the acquired data. This entailed investigating connections and relationships between various parameters. Multiple Regression Analysis was used to determine how numerous independent factors influence a single dependent variable. This method allowed us to determine the significance and magnitude of each independent variable's effect on the dependent variable.

The adopted model was be presented as follow:

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$

Where: Y= Climate Change management, α= Constant Term, X_1= Value added taxes, X_2= Income taxes, X_3= district revenues, β= Beta Coefficient, ε= the error term

Correlation Analysis was used to evaluate how strongly and in which direction two variables are connected. This statistical method determines how closely changes in one variable are related to changes in another, providing insight into whether the patterns of change are similar or dissimilar. The strength of this link is determined by correlation coefficients such as Pearson's correlation coefficient. A positive correlation means that as one variable rises, the other rises as well, and vice

versa. A negative correlation, on the other hand, indicates that as one variable increases, the other tends to decrease.

The Analysis of Variance (ANOVA) was used to investigate differences in greenhouse gas emissions across different categories or sectors in order to discover any significant differences. It calculates both between-group and within-group variances, resulting in an F-statistic that is compared to a critical value or p-value to assess if the variations in means are statistically significant or just chance occurrences. This strategy can help you understand how the e-tax system influences tax collection in different areas.

IV. DATA ANALYSIS AND RESULTS DISCUSSION

Interpretations are provided after each table where necessary, always taking into account the initial secondary data from Rwanda Revenue Authority and REMA employees interviews. The analysis reflects the objectives of the study and verify as well the set hypothesis. Once this point has been reached, it is clear that climate change mitigation will be addressed by the study.

Demographic characteristics of respondents
Collecting demographic data is crucial in research because it aids in understanding the composition of the study population and identifying any potential biases that may affect the results.

Gender of the respondents

Table 3 – Distribution of respondents by gender

Gender	Frequencies	%
Male	61	40.67%
Female	89	59.33%
Total	**150**	**100.00%**

Source: Primary data

The study's gender distribution among participants was a major discovery. Around 40.67% of the total participants, or 61 people, were male, while around 59.33%, or 89 people, were female. As a result, both genders were fairly represented in our study. Recognizing the importance of gender inclusion in research, balanced involvement ensures that both male and female viewpoints are captured. This increases the research's robustness and comprehensiveness, enabling a more holistic grasp of the topic.

Age of the respondents

Table 4 – Distribution of respondents by age

Age of respondents	Frequencies	%
18 – 25 years	20	13.33%
26 – 35 years	76	50.67%
36 – 55 years	41	27.33%
Over 55 years	13	8.67%
Total	**150**	**100.00%**

The table 4 reveals that 50.67% of the entire sample is between the ages of 26 and 35, showing a considerable level of participation or impact of the subject matter under investigation on this age group. Furthermore, 27.33% of respondents are between the ages of 36 and 55, indicating a substantial presence of middle-aged people in the survey. This age variety adds value to the data by gathering opinions from different life stages. The range of age groups enriches the data by providing viewpoints from diverse periods of life. It is worth mentioning that the age range of 18 to 25 years, which accounts for 13.33% of the participants, contains younger persons who may provide useful insights regarding the relevance of the research topic to the youth. In addition, respondents above the age of 55 (8.67%) are included, indicating the views of the elder generation. This demographic breakdown emphasizes the study's inclusive participant base, ensuring that the research findings reflect a diverse spectrum of age-related opinions.

Education of respondents

Table 5 – Distribution of respondents by level of education

Education level	Frequencies	%
Certificate	0	0.00%
Diploma	2	1.33%
Bachelors	90	60.00%
Masters and above	58	38.67%
Total	**150**	**100.00%**

Table 5 shows a breakdown of the participants' educational levels. The majority of the 150 responders (60.00%) hold Bachelor's degrees, indicating a considerable proportion of individuals with undergraduate education. Furthermore, 38.67% of participants had Master's degrees or higher, indicating a significant presence of people with advanced academic backgrounds. Nonetheless, it is worth noting that none of the participants possessed certificates, and only 1.33% possessed diplomas. This distribution emphasizes the study's participants' excellent educational achievements, with a concentration on undergraduate and postgraduate qualifications. This diverse educational background provides a helpful perspective for the research because it comprises a wide range of academic experiences and perspectives that can significantly improve the study's discoveries and overall quality of analysis.

Working experience of respondents

Table 6 – Distribution of respondents by working experience in organization

Working experience	Frequencies	%
Less than 1 year	16	10.67%
1 – 3 years	36	24.00%
4 – 5 years	51	34.00%
6 – 8 years	13	8.67%
9 – 10 years	24	16.00%
11 years and above	10	6.67%
Total	**150**	**100.00%**

Table 6 depicts the distribution of respondents based on their job experience within organizations. The results show that there is a diverse representation of individuals with varying degrees of experience. The bulk of respondents (34%), have 4 to 5 years of experience, indicating the existence of a sizable number of mid-level professionals in the sample. Furthermore, 24% of participants had 1 to 3 years of experience, showing a sizable proportion of people in their early careers. A sizable proportion of seasoned professionals, 16% of those polled, had worked for 9 to 10 years. A smaller proportion of respondents have less than one year of experience (10.67%), 6 to 8 years (8.67%), or 11 years or more (6.67%). This distribution shows a fair representation of different career stages, which adds to the credibility and comprehensiveness of the insights gained from the study's wide group of participants.

Descriptive statistical analysis for study objectives analytics

In this section, data collected through questionnaires distributed to the employees of Rwanda Revenue authority and that of Rwanda environment management authority. The findings in this section are analyzed using "Mean scored" method to get insights from the data. The analysis was deeply addressing the specific objectives of the study.

Effect of value added taxes on climate change management in Rwanda

The first goal of this research was to determine how value-added taxes affect climate change management in Rwanda. Respondents were asked to rate their level of agreement or disagreement with statements about this topic. To summarize the data collected from the participants, descriptive statistics such as averages and standard deviations were used.

Table 7 -Effect of value added taxes on climate change management in Rwanda

Statement	N	Mean	SD
Value Added Taxes effectively incentivize the reduction of greenhouse gas emissions in Rwanda.	150	4.26	0.35
The revenue generated from Value Added Taxes is adequately allocated to climate change mitigation and adaptation measures in Rwanda.	150	3.01	0.26
Value Added Taxes have a significant impact on promoting sustainable development and addressing climate change challenges in Rwanda.	150	4.54	0.38
Value Added Taxes are an effective tool for encouraging the conservation of natural resources and promoting a greener economy in Rwanda.	150	4.64	0.40
The implementation of Value Added Taxes positively contributes to climate change management in Rwanda.	150	4.87	0.43
Value Added Taxes encourage businesses to adopt environmentally friendly practices in Rwanda.	150	3.14	0.26

The table provides crucial insights into the perceived impact of value-added taxes (VAT) on climate change management in Rwanda based on a poll of 150 people. The mean scores show the respondents' average judgements of the effectiveness of VAT in various aspects of climate change management, which vary from 3.01 to 4.87. The statement "The implementation of Value Added Taxes positively contributes to climate change management in Rwanda" obtained the highest mean score of 4.87, with a reasonably low standard deviation (SD) of 0.43. The findings show that respondents generally think that introducing VAT has a positive influence on climate change management, suggesting universal trust in its effectiveness. The statement on the proper allocation of revenue from Value Added Taxes to climate change mitigation and adaptation measures in Rwanda, on the other hand, obtained a lower average score of 3.01, with a relatively modest standard deviation of 0.26. According to the statistics, there is disagreement among individuals polled regarding whether the funding allocated for climate change activities in Rwanda are adequate. This implies that there is still opportunity for improvement in allocating VAT income to these

endeavors. Overall, the results demonstrate that people have a favourable view of VAT's involvement in climate change management, but there are several areas where it may be improved.

From their work Da , Xinlin, Ruochan, & Zhiliang (2022), claim that many economists support VAT on carbon as a tool for reducing carbon emissions; emissions embedded in Irish household imports surpass those embedded in Irish exports. While the tax simply raises inequality and disproportionately affects lower-income households, the combined carbon tax and transfer increase shields some of the lowest-income households from the cost. The income tax cut mostly favours middle-to-upper-income households and limits the reduction in working hours seen in the other two scenarios. Both income recycling techniques marginally reduce the predicted reduction in emissions. While for Yu, Jianshun, & Jianwei (2023), they discovered that the average effect of the VAT change on emissions is a 16.6% drop in the intensity of SO_2 emissions. Assuming that there is no regulation, we will use the zero SO_2 reduction target.

Effect of income taxes on climate change management in Rwanda

The secondary objective of the study was to determine how income taxes impact climate change management in Rwanda. Participants in the survey were asked to rate their degree of agreement with statements on the influence of income taxes on climate change management in Rwanda. Means and standard deviations were utilized in descriptive statistics to offer a concise overview of the participants' replies.

Table 7 – Effect of income taxes on climate change management in Rwanda

Statement	N	Mean	SD
Income taxes contribute to funding climate change management initiatives in Rwanda.	150	2.71	0.26
The implementation of income taxes encourages individuals and businesses to adopt eco-friendly practices in Rwanda.	150	3.01	0.26
Income taxes effectively incentivize the reduction of carbon footprints among Rwandan citizens.	150	3.07	0.26
The revenue generated from income taxes is adequately utilized to support climate change mitigation and adaptation efforts in Rwanda.	150	3.04	0.26
Income taxes play a significant role in promoting sustainable development and addressing climate change challenges in Rwanda.	150	3.27	0.26
Income taxes are an effective tool for encouraging responsible consumption and sustainable lifestyles in Rwanda.	150	2.78	0.26

Source: Primary data

In Rwanda, a table displaying the Mean and Standard Deviation (SD) values for several claims addressing the impact of income taxes on climate change management has been created. These numbers provide insight on how 150 respondents see the impact of income taxes on climate change measures. On average, respondents believe that income taxes have a beneficial influence on Rwanda's climate change management. This is reflected in the Mean value of 3.01 and the low Standard Deviation of 0.26, indicating that respondents' opinions are quite stable.

The essay addresses Rwandan individuals' perceptions on the efficiency of income taxes in motivating carbon footprint reduction and supporting sustainable development. The mean values of 3.07 and 3.27, with small standard deviations, suggest a substantial agreement among respondents on the good impact of income taxes in solving climate change problems. This shows that income taxes are viewed as a beneficial instrument for promoting environmentally friendly practices and helping to Rwanda's climate change management efforts. Overall, these findings emphasize the need of establishing policies that promote sustainable growth and lower the country's carbon footprint.

With use of example of income taxes reforms and application to mitigate the climate

changes through emissions of CO_2 or/and other toxic gases; the results of this study refer to that of Olive, (2022) who stated that Argentina's Tax Reform has changed the fuel tax, which now takes into account the level of carbon dioxide emissions. This reform initially relates to liquid fuels, but beginning in 2020, it will also apply to natural gas, liquefied petroleum gas, and coal. The political decision to use these economic methods include a framework that specifies the amount of emissions as well as a levy that imposes a fee for each unit of emission from a contributing source.

Carbon taxes give greenhouse gas emissions a monetary value, which stimulates the whole economy to invest in cleaner technologies. On the hand, Žiga, Maja, & Damjan (2014) found that the income taxes have been shown to have a direct detrimental influence on greenhouse gas emissions. Furthermore, the indirect impact of these taxes via environmental expenses is negative and statistically significant. The same affirmation was given by the research of Parry (2019) who said that implementing an income tax through a carbon

tax could reduce usage of fossil fuels while increasing use of cleaner energy sources. This would eventually result in lower carbon dioxide (CO2) emissions, which are the principal source of greenhouse gas emissions.

The findings are supporting the statement of Tax Foundation (2023) whom stated that as a carbon tax, an income tax is primarily used to put a monetary value to emissions, resulting in higher prices for emissions-heavy products and services when compared to others. This inhibits the emission of greenhouse gases, resulting in a decrease in their concentration in the atmosphere and, as a result, a reduction in the detrimental effects of global warming.

Impact of the tax's exemption on climate favored cars

To promote climate sustainability and environmental protection, the government of Rwanda exempted a percentage of taxes on electric and hybrid vehicles.
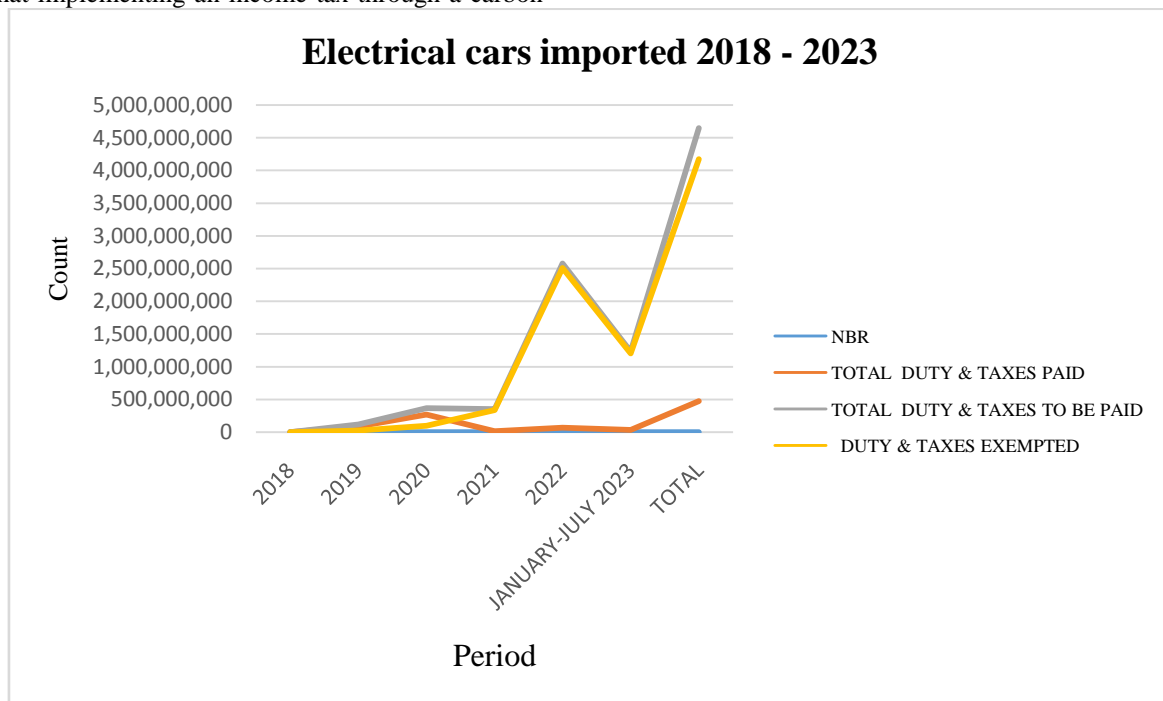

Figure 1 - Electrical cars imported

No electric cars were imported in 2018, which means no duty or taxes were paid or exempted. However, there has been a notable rise in the number of imported electric cars in the following years, with a total of 276 imported by July 2023. The amount of duty and taxes paid has steadily increased from 2019 to 2022, eventually reaching 474,832,281 Rwandan Francs. The amount

of duty and taxes paid increased gradually from 2019 to 2022, reaching a total of 474,832,281 Rwandan Francs. The significant rise in the duty and taxes owed, from 115,844,553 in 2019 to 2,576,809,768 in 2022, highlights the growing value of imported electric cars. It is worth noting that there was also a considerable increase in the total amount of duty and taxes exempted, reaching

4,173,144,086 Rwandan Francs. This demonstrates the substantial financial incentives provided to

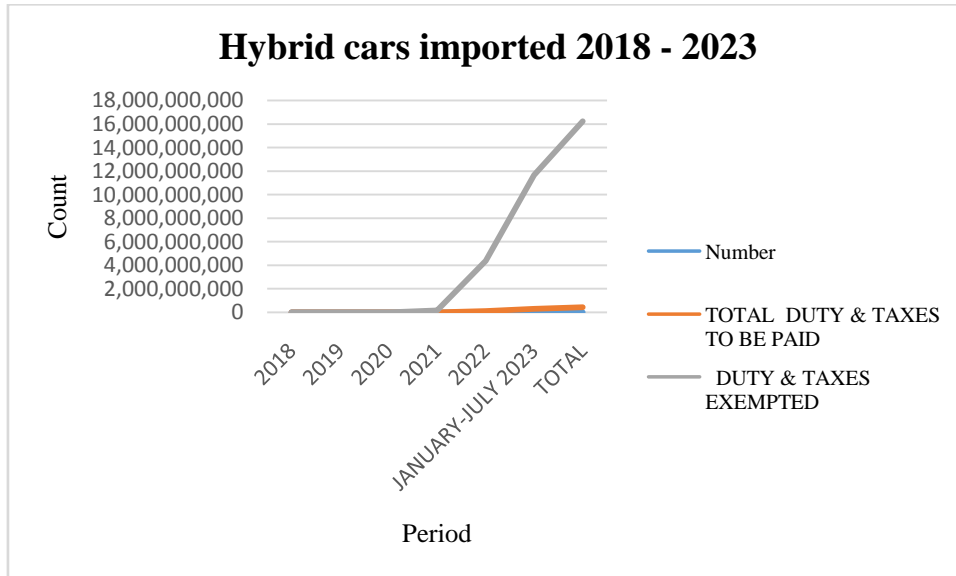encourage the adoption of environmentally friendly electric vehicles in Rwanda.

Figure 2 - Hybrid cars imported 2018 – 2023

In 2018, one hybrid car was imported, with a total duty and tax of 1,619,539 Rwandan Francs. Out of this amount, 2,105,839 Rwandan Francs were exempted. There were no hybrid car imports in 2019 and 2020. However, in 2021, 28 hybrid cars were imported, resulting in a total duty and tax of 8,676,284 Rwandan Francs. A substantial exemption of 174,725,482 Rwandan Francs was granted. The trend continued in 2022, with 521 hybrid cars imported. The total duty and tax amounted to 114,681,050 Rwandan Francs, and a significant exemption of 4,376,688,761 Rwandan Francs was provided.During the first half of 2023,

there was a significant rise in the importation of hybrid cars, with a total of 1,314 vehicles being imported. This resulted in a sum of 317,002,049 Rwandan Francs being collected in duty and taxes, while an impressive exemption of 11,665,848,958 Rwandan Francs was granted. Overall, a total of 1,864 hybrid cars were imported, accumulating a duty and tax amount of 441,978,922 Rwandan Francs. Additionally, there was a substantial exemption of 16,219,369,040 Rwandan Francs. These figures emphasize the substantial impact that tax exemption has on promoting the use of environmentally friendly cars in Rwanda.
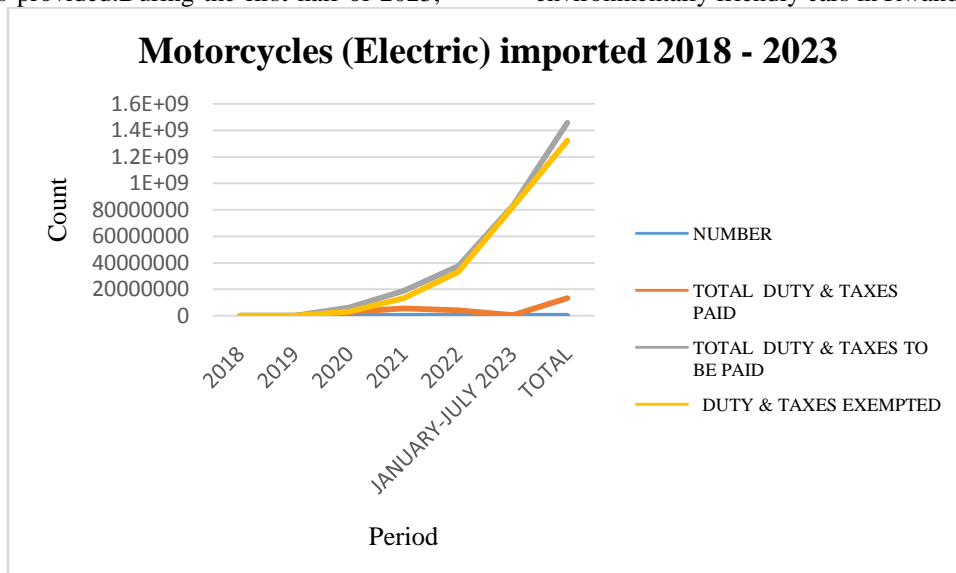

Figure 3 - Imported electrical motorcycles 2018-2023

No motorcycles were imported in 2018. However, in 2019, a total of 4 motorcycles were brought in, and a sum of 1,124,436 Rwandan Francs was paid in duty and taxes. It is worth noting that no exemptions were granted for duty and taxes. Subsequent years saw a notable rise in both the quantity of imported motorcycles and the corresponding duty and taxes.In 2020 and 2021, a significant amount of duty and taxes were waived, amounting to 32,374,086 and 132,695,704 Rwandan Francs respectively. This trend continued in 2022 and the first half of 2023, with a total of 332,298,253 Rwandan Francs waived in 2022 and 825,465,417 Rwandan Francs in the first seven months of 2023. The cumulative figures show a substantial impact of tax exemptions, totaling 1,322,833,460 Rwandan Francs, which could potentially encourage the importation of motorcycles that are favored for their climate-friendly features.

Inferential statistics

As depicted within the conceptual framework, and then by the regression model in the methodology section; this research verifies the how the Value Added Taxes, Income taxes, and District revenues impact the climate change management which has for components, Greenhouse Gas Emissions. Using SPSS, a regression model has been conducted and following are the results. Through the calculation of their mean values, the data was merged to form distinct variables for each factor. Following that, a Pearson Correlation analysis and a Multiple Regression Analysis were performed with a 95% confidence interval and a significance threshold of 5%. The results of these analyses are presented in the sections that follow.

Correlation analysis

In particular, the connection results shed light on how Rwanda's income taxes, value added taxes (VAT), and nitrogen dioxide (NO2) levels relate to the country's efforts to manage climate change. A somewhat positive link is indicated by the Pearson link coefficient of 0.635 between VAT and NO2. This implies that NO2 levels tend to rise in tandem with VAT hikes, indicating a possible impact of VAT on environmental variables.

Table 9 - Correlation test results

		VAT	Income Taxes	NO2
VAT	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	6		
Income Taxes	Pearson Correlation	.502	1	
	Sig. (2-tailed)	.311		
	N	6	6	
NO2	Pearson Correlation	.635	.777	1
	Sig. (2-tailed)	.176	.069	
	N	6	6	6

On the other hand, the correlation coefficient between Income Taxes and NO2 is 0.777, indicating an even larger positive association. These findings highlight the significance of tax policy in tackling climate change in Rwanda by indicating that income taxes may have a major influence on NO2 levels. It's crucial to remember that both correlations' significance levels (Sig. values) are higher than the customary 0.05 cutoff, suggesting that care should be taken when drawing firm conclusions and that more investigation may be required to confirm and fully explore these relationships.

Regression analysis

Table 10 - Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.827[a]	.684	.474	.25670

a. Predictors: (Constant), Income Taxes, VAT

Regression analysis results indicate that the model fits the dependent variable well, with a moderately significant correlation (R = 0.827) between the predictors (VAT, income taxes, and constant) and the dependent variable. With a coefficient of determination (R Square) of 0.684,

the factors examined in the analysis can be responsible for approximately 68.4% of the variation in Rwanda's climate change management. The model's adjusted R Square, which accounts for the number of predictors, is 0.474. This shows a marginally lower value but nevertheless points to a strong fit for the model. The model's precision in predicting outcomes is indicated by the standard error of the estimate, which stands at 0.25670. Further research of the regression coefficients for VAT and income taxes would be required to assess each tax's unique effects on Rwanda's climate change management in order to precisely address the goals.

Table 11 - ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.428	2	.214	3.250	.177[b]
	Residual	.198	3	.066		
	Total	.626	5			

a. Dependent Variable: NO2
b. Predictors: (Constant), Income Taxes, VAT

The combined effect of income taxes and VAT does not significantly explain the variation in NO2 levels in the context of climate change management in Rwanda, according to the overall regression model's lack of significant results (F=3.250, p=.177). This implies that income taxes and VAT, either by themselves or in combination, do not appear to be significant determinants of NO2 levels according to the current analysis, casting doubt on their ability to directly address climate change. To better comprehend the intricate interaction between tax policies and environmental consequences in the unique setting of Rwanda, more research and model development may be required.

Table 12 - Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-3.473	1.700		-2.043	.134
	VAT	.144	.166	.327	.872	.448
	Income Taxes	1.060	.648	.613	1.636	.200

a. Dependent Variable: NO2

With a t-value of -2.043 and a p-value of 0.134, the constant term suggests that the expected level of NO2 is -3.473 while the other factors stay constant. However, this result is not statistically significant. With a t-value of 0.872 and a p-value of 0.448, the coefficient for VAT is 0.144 and its standard error is 0.166, suggesting a positive connection between VAT and NO2. However, this finding is not statistically significant. The coefficient for income taxes, on the other hand, is 1.060 and has a 0.648 standard error, suggesting a positive association with NO2. The findings show that there is no statistically significant correlation (t = 1.636, p = 0.200) between the assessed taxes, such as income taxes and value-added taxes, and nitrogen dioxide concentrations. These results imply that the amounts of nitrogen dioxide may not be accurately predicted by these taxes. It could be necessary to do further research or take into account other elements in order to better understand their function in managing climate change in Rwanda.

V. CONCLUSION

The study makes use of primary data that was gathered from 150 individuals who work for the Rwanda Environment Management Authority and the Rwanda Revenue Authority. A variety of viewpoints are represented in the study due to the balanced representation of gender, age, education, and work experience, as demonstrated by the demographic analysis. Using statistical analysis, the study's primary goal,examining how value-added taxes affect the management of climate change,is met. The respondents' average scores show that the impact of VAT on different facets of climate change management is largely seen favorably. The statement "The implementation of Value Added Taxes positively contributes to climate change management in Rwanda" receives the highest average score of 4.87. There may be

space for improvement in this area as there are conflicting views on how much of the VAT money should go towards adaptation and mitigation efforts against climate change.According to the study for the second objective, which evaluates how income taxes affect climate change management, respondents think income taxes have a favorable effect on policies aimed at combating climate change. The mean values fall between 2.71 and 3.27, which is consistent with the body of research supporting the hypothesis that income taxes can reduce carbon footprints. One example of this is the effect Argentina's Tax Reform had on gasoline taxes and carbon dioxide emissions.

Using regression analysis and other inferential statistics, the links between income taxes, VAT, and nitrogen dioxide (NO_2) levels—a proxy for managing climate change—were investigated. According to the correlation analysis, VAT and NO_2 have a positive relationship (Pearson correlation = 0.635), and an even greater positive. The model that incorporates income taxes and VAT as predictors fits the dependent variable (NO_2) reasonably well, according to the regression analysis's results (R = 0.827, R Square = 0.684). With an adjusted R Square of 0.474, the model appears to be well-fitting data. The combined impact of income taxes and VAT, however, does not appear to be a major factor in explaining the difference in NO_2 levels, according to the ANOVA results.

It is evident from the regression model's coefficients that there is no statistically significant association between income taxes or VAT and NO_2 concentrations. Both the income tax (p = 0.200) and the VAT (p = 0.448) have p-values over the conventional 0.05 cutoff, suggesting that these taxes may not be important factors influencing the levels of NO_2 in the context of climate change management in Rwanda.Additional research and model refinement may be required to gain a comprehensive understanding of the complex connection between tax policies, such as VAT and income taxes, and their impact on climate change management in Rwanda, despite the valuable insights provided by this study.

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