Challenges of climate change on revenue collection performance in Rwanda: A case of Rwanda Revenue Authority

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https://doi.org/10.51867/ajernet.6.3.87

ABSTRACT

High revenue collection performance is essential for enhancing efficiency in service delivery and fostering economic development at the county level. However, numerous studies indicate that many countries encounter significant challenges in their revenue collection efforts. The main purpose of this study was to investigate the effect of climate change challenges on revenue collection performance in Rwanda. Specifically, this study assesses the effect of loss of biodiversity on revenue collection performance in Rwanda, evaluates the effect of generation of hazardous and solid waste on revenue collection performance in Rwanda, and evaluates the effect of natural resource depletion on revenue collection performance in Rwanda. This study is guided by optimal tax theory, waste management theory, and resource depletion theory. The research utilised a descriptive research design. The study population consists of 791 employees from various departments within the RRA and a sample size of 89 respondents. This study utilised primary instruments such as a questionnaire. This study employed a quantitative research approach, utilising both descriptive and inferential statistics to analyse data. The results show that overall, a very high mean of 4.14 for combined statements indicates an overall very strong positive agreement that there is an effect of biodiversity loss on revenue collection performance, with a standard deviation of 0.903, signifying some variety in responses among respondents. In addition, the overall very high mean score of 4.20 for the blended statements deliberates an overall very strong positive agreement that there is an effect of the generation of hazardous and solid waste and revenue collection performance, with the standard deviation of 0.879 designating some variability in opinions, and the overall high mean of 3.98 for the combined statements indicates an overall strong positive agreement that there is an effect of natural resource depletion on revenue collection performance, with a standard deviation of 1.070, signifying some variety in responses among respondents. The study outlines recommendations for the Rwanda Revenue Authority (RRA) to enhance revenue streams from eco-friendly industries and enforce environmental regulations. The suggestions include supporting renewable energy and sustainable agriculture, promoting green public procurement, integrating environmental considerations into tax policy, and fostering collaboration among government agencies to ensure a cohesive approach to sustainability and revenue generation.

Key words: Biodiversity Loss, Climate Change Challenges, Generation of Hazardous, Natural Resource Depletion, Revenue Collection Performance, Solid Waste

I. INTRODUCTION

Revenue collection refers to the procedure by which governments, or organizations, collect money via numerous sources specifically, the taxes, fees, and other financial instruments (Lopez et al., 2022). Nevertheless, the efficiency of tax collection is getting moribund due to the influence of climate change. The challenges not only break the economic flow but also lower the taxable income as well as pressure the public resources, which ultimately impacts the overall performance of the revenue collection systems (Khan et al., 2021). There is a constant pressure on the government to generate more revenues yearly to optimize different important sectors. The enhancement of infrastructure, healthcare services and an attempt to counter social inequality are some of the areas of concern. The needs create the need to emphasize the relevance of sustainable revenue generation schemes towards the general welfare of the society (Kamau, 2023).

Moreover, the governments tend to run at a deficit, and this is due to failure to meet the increasing needs of people in terms of accessing government services and the infrastructure. This is the case that demonstrates the real problem of accompanying revenue collection with the delivery of the basic services, and most governments fail to maintain both. Moreover, the issue of climate change is also posing serious problems in discharging the government with revenue potential (Huynh & Hoang, 2025). Mawejje (2024) argues that climate change is a serious challenge affecting the performance of any revenue collection at an intersectoral level. These extreme weather conditions are growing in number and intensity which can adversely affect economic activity, causing low tax revenues and financial security problems to governments. Angba et al. (2020) stated that the occurrence of climate-related disturbances greatly affects business efficiency on the other hand.

Globally, Ali et al. (2020) asserts that the governments of the world have always had to use revenue collections to finance services to their populations. Within the last twenty years, there has been the pronounced movement of international leaders to initiate reforms that would improve revenue collection. The International Monetary Fund (IMF) has supported this movement by working on the skills, professionalism, and human resources of all governments in their tax revenue authorities around the world.

Also, the problem of climate change has become a threat to the efficiency of income-generating activities that justifies considerations in the fiscal policy of adaptation. This has created profits in the course of time in some countries. In 2023, Organisation for Economic Co-operation and Development (OECD, 2024) ranked France and Denmark as the highest tax revenue collecting countries with their totals standing at 43.8 and 43.4 respectively. The highest increase was in the tax revenue of Luxembourg that increased by 2.7 percentage points mostly due to 1.2 percentage point increase in personal income taxes and a 0.8 percentage point increase in social security contributions. Colombia also registered an impressive growth in its tax revenues of 2.6 percentage point of Gross Domestics Product (GDP) growth mainly due to 2.2 percentage point growth in corporate income tax revenues. The tax revenues of Tuerkye were up by 2.5 percentage points, of which tax revenues on goods and services had gone up by 1.6 percentage points and social security contributions by 1.1 percentage points.

In contrast, Mexico registered the least tax revenues with only 17.7%. Moreover, Chile had the largest decrease in the tax revenue with the tax revenue decreasing by 3.2%, which was largely attributed to the decline in the revenues generated by income and profits taxes. Korea was followed by a decrease of 3.1 percentage points with the revenue growth sector where personal income tax revenues declined by 0.8 percentage points, the corporate income tax revenues declined by 1.2 percentage points and the revenues on taxes on goods and services did escalate by 0.7 percentage points (OECD, 2024). Other countries, as a way of dealing with the cost-of-living crises, have remained to use tax policy as an instrument of easing financial constraints. This strategy is amidst growing calls towards ever-enlarging government expenditure based on long-term challenges such as climate change and even the aging population which are likely to require more revenue generation, in the forthcoming years. This is what puts forward the determination of the present study to examine the impact of climate change challenges on the performance of revenue collection.

In regional perspective, according to the United Nations Development Programme (Olaleye et al., 2024), the tax revenue of Sub-Saharan Africa (SSA) is significantly small as compared to other international territories such as Asia and the Pacific, Latin America and the Caribbean, and OECD countries. In Sub-Saharan Africa, the average tax revenues were 15.6 percent in 2021 with respect to 33 countries in Sub-Saharan Africa. Tax revenues were quite different in the other countries and Equatorial Guinea had the lowest at 5.9 percent and Tunisia the highest at 32.5 percent. Botswana registered the highest increment of tax-to-GDP ratio at 2.8 percent, South Africa 1.9 percent and Democratic Republic of the Congo 1.8 percent.

In contrast, Chad faced the most considerable decline, with a drop of 4.6 percentage points, succeeded by the Seychelles at 2.6 percentage points and Equatorial Guinea at 2.5 percentage points (Olaleye et al., 2024). This figure highlights the challenges faced by the region in generating tax revenue relative to its economic output. In this regard, the Sub-Saharan countries are grappling with a significant trilemma regarding taxation (Asiedu et al., 2024). According to authors, the economically capable individuals are few in number and often seek tax planning and avoidance strategies, demonstrating a reluctance to contribute to the tax system, the majority of the population lacks economic means, resulting in minimal taxable income and resistance to tax payments and the challenges posed by climate change further complicate revenue collection efforts. This highlights the significance of understanding how challenges of climate change influence financial systems and revenue generation. In this way, the investigation seeks to identify the association between specific challenges posed by climate change that may hinder effective revenue collection.

Rwanda tax in the Rwandan government has been falling by 0.5 percentage points since the year 2021, which was 17.0 to 16.5 in the year 2022. Conversely, in 36 countries of Africa, provided in the Revenue Statistics in Africa 2024 publication, the tax-to-GDP ratio rose by the same amount, 0.5 percentage point, over the same time and reached the level of 16.0 percent in 2022. This shows that there are differences in the trend of tax revenues in Rwanda when compared to that of Africa as a whole, which reflects on a possible difficulty in the fiscal policy or economic performance of Rwanda compared to others. Niyonizera and Twesigye (2024) explain that the reforms which have taken place in Rwanda have played a major role in enhancing the effectiveness of the Rwanda Revenue Authority (RRA) in collecting tax.

Nevertheless, in all these gains, the RRA still faces diverse challenges that hamper the realization of the much-needed tax revenue. Such problems might comprise the taxation compliance, administrative capability, and general economic conditions, which would influence the capability of the government to mobilize the tax revenue efficiently to developmental uses. Also, the climate change poses a great challenge to the local governments, which hinders earning and administration of revenues being used in the area. Such climate change adversities influence the revenue collection in terms of performance (Bikorimana et al., 2024).

Through observation of these challenges, the research aims at offering certain challenges that ought to be considered in climate change that might assist in enacting policies and their management of generating revenue. This is

why the present research project is undertaken to examine how climate change challenges impacts on the performance in revenue collection. The scopes of this research centered on the role of climate change in improving the revenue collection performance in Rwanda. There are three areas of concern identified. First, it seeks to evaluate the effect that the loss of biodiversity has on revenue collection where economic consequences of dwindling ecosystems are noted. Second, the research considers the effect of generating the hazardous and solid waste on the performance of revenue, which should imply that in waste management operations, there can be serious consequences in monetary terms. Finally, it discusses the implication of natural resource depletion on revenue collection, thus implying that resource sustainability plays a very key role in ensuring that the economy is stable. Generally, this study aims at learning how environmental issues and financial wellbeing go hand in hand in Rwanda.

1.1 Statement of the Problem

How well a service is delivered and the economy improves is founded on how well revenue is collected (Wako, 2023). Nonetheless, there is a lot of research that shows that because of the problem of climate change, many nations face serious difficulties in their revenue collection courses. In the case of the United Kingdom the revenues were determined based on the climate changes (Lopez et al., 2022): Revenue collection is poor due to climate change, can be followed by the rate of mortality of the Vietnamese biodiversity (Huynh & Hoang, 2025). Further, poor performance of revenue collection is also explained by factors such as narrow tax base, assessment of revenue sources and climate change in Tanzania (Kayombo, 2023), in Uganda, poor performance of revenue collection is attributed to weather and climate change shocks (Mawejje, 2024).

The contribution that RRA makes to the national budget is 51.2% in 2023/24, up from 48.9% last year. But this is influenced by external factors such as climate change problems. Such adverse effects of climate change negatively influence economic activities resulting in a decline in taxes, e.g. Rwf24.5 billion loss through illegal fishing in Lake Kivu, on Lake Muhazi, the death of thousands of fishes caused by the depletion of dissolved oxygen during water turnover, triggers fish during algal bloom (Hategekimana et al., 2020).

In addition, as pollinators (one-third of world food production) or their disappearance being an impact on food production and food prices, and agricultural taxes, forest destruction and timber destruction and degradation, the tax-paying industries, which rely on forestry, weaken. In addition, production of hazardous and solid wastes including uncontrolled wastes, most of them in and around the tourist areas can be a cause of bad environment, which may scare away the tourists and impact on the tourism revenues, bad waste disposal may escalate many diseases, increasing healthcare spending, and bad waste disposal will destroy infrastructures, thereby interfering with businesses. Besides this, natural resources like soil degradation through exposure to pollutants, has a degrading impact on the amount of taxes to be collected Rwanda Environment Authority (Ozunu et al., 2024).

Very little research was done on revenue collection performance and other challenges. Examples include Chemouni (2020), who investigated effectiveness of the RRA and top-down pressure of perverse incentives in the organization; Hagenimana and Niyibizi (2022), who investigated voluntary compliance among taxpayers and financial statement audit and revenue collection; and Niyonizera and Twesigye (2024), who investigated problems linked to weak tax administration and enforcement with the Rwanda tax system. The available literature on Rwanda revenue collection performance suffers weaknesses especially in their inability to capture the impact of climate change issues. This study seeks to close that gap by evaluating in particular the impact of climate change on revenue collection in Rwanda. The research aims at exploring how the issue of climate change affects the performance of revenue collection in Rwanda.

1.2 Research Objectives

i. To assess the effect of loss of biodiversity on revenue collection performance in Rwanda
ii. To analyze the effect of generation of hazardous and solid waste on revenue collection performance in Rwanda
iii. To evaluate the effect of natural resource depletion on revenue collection performance in Rwanda.

1.3 Research Hypotheses

H0₁ There is no significant effect of loss of biodiversity on revenue collection performance in Rwanda;
H0₂ There is no significant effect of generation of hazardous and solid waste on revenue collection performance in Rwanda;
H0₃ There is no significant effect of natural resource depletion on revenue collection performance in Rwanda.

II. LITERATURE REVIEW

2.1 Theoretical Underpinning

2.1.1 Optimal Theory of Taxation

The general concept of optimal taxation as promoted by Stiglitz in 1987 focuses on the need of constructing a tax regime which would facilitate maximum social welfare. This is informed by the fact that there is a need to act within a given constraint and this could be on economic, social, administrative and environmental terms. The theory emphasizes on the maximization of the social welfare function in order to have a conceptual framework of assessing and prescribing the taxation policies to meet the desired economic goals.

To Boadway (2012), optimal tax theory is an underlying paradigm used to formulate a tax structure that is inefficient. This theory stresses on the relevance of devising taxation structures that limit the economic distortions and at the same time provide a reasonable allocation of taxes impacts on both people and companies. According to this theory, the primary objective of an ideal taxation scheme would be the equilibrium between the necessity to get revenue and the possibility to encourage productive economic behavior. It implies that the taxes need to be designed in a manner that minimizes any inequalities without largely affecting the tax collection rates.

Optimal Tax Theory was characterized by Best et al. (2015) to focus on the rates of tax to be designed knowing that the rates of tax need to maximize social welfare, but to understand the tax behavioural effects, equity and revenue outcomes. The relationships between revenue collection and economic distortion are another important feature of this theory, and an important point being made in policy debate. This balance is essential in effective taxation because it aims to attain both financial as well as fairness without inflicting a negative impact on economic activity. Analysis of multiple-sources-of-income, unobserved-heterogeneity optimal tax problems is complicated in the field of public finance. This can be proven by the fact that income stream diversities have to be taken into consideration and variations in individual circumstances which cannot be directly observed have to be considered, so this is made complex.

Boadway (2012) added that optimal tax theory models focus on the importance of setting up a tax system in which social welfare is maximised with a given government budget constraint. These models consider the behavioral superset of individuals on taxes and transfers and note that there is a necessity to perceive how the superset upon taxes and transfers might affect the general revenue collection and impair the proficiency of the economy.

Moreover, the theory reflects on the uncertainties that are present because of climate change and the tax policy, as well as the tax policy, should also take the environmental effects and sustainability into consideration (Josheski, 2022). Moreover, Optimal tax theory (OTT) is a useful theory of the construction of the taxation systems aimed at finding harmony between efficiency and justice. In the case of Brazil, the use of OTT is greatly beneficial to the tax policy in that it can be used to improve the making of a tax system that can not only maximize efficiency but also be fair. This practice is expected to advance social wellbeing, and at the same time increase the revenue collection performance (Carvalho e Costa & Vieira, 2020).

This theory is meaningful to this research because Optimal Tax Theory helps in comprehending the effect of the loss of biodiversity on the performance of revenue collection. The proposal of the theory implies that the taxation system must be established in such a way so as to ensure that economic distortions are reduced to an absolute minimum with maximized social welfare Boadway (2012). The use of ecosystem services to provide economic activities and tax revenues is threatened with declines in biodiversity hence potential decline in the revenue of the government. Also, the link between the tax revenue and biodiversity is important where healthy ecosystems contribute in industries like agriculture, tourism and fisheries which are crucial in the collection of taxes. The industries can also be affected through the impairment of biodiversity, and this can lead to the reduction in tax revenue and a rise in the economic uncertainty. Hence, tax best practice concepts and environmental integration criteria maximized tax collection via the embracement of a sustainable practice strategy that safeguards biodiversity (Best et al., 2015).

2.1.2 Waste Management Theory

The Waste Management Theory (WMT) which has been formulated by Eva Pongrácz, Paul Phillips, and Riitta Keiski offers an elaborate plan by which waste and waste management can be comprehended. The theory was introduced in the year 2004 and focuses more on holistic thinking and strongly anchors in the aspects of industrial ecology (Pongrácz et al., 2004). The current work is intended to unify the diverse elements of the waste management process not only by supporting sustainable behaviors but by viewing waste as more of a resource than a product.

The Waste Management Theory, as Chen et al. (2016) claim, is used to help analyze all the complexities that accompanied the generating, management, and disposal of wastes. It is mainly aimed at minimizing the negative impact on the health of the population, as well as of the environment. The theory notes that environmental, economic, and social aspects of waste management strategies should be taken into account in the approaches, and more unique solutions should be aimed at complying with the objectives of sustainable development.

In addition, Palafox-Alcantar et al. (2020) note that the Waste Management Theory plays a vital role in perceiving the problems and patterns of waste production and disposal in contemporary society. The theory supports a

systematic approach of waste management that encompasses reduction, reuse, recycling, and responsible disposal. Moreover, Kurniawan et al. (2024) have identified that Waste Management Theory can be instrumental in dealing with the challenges of climate change by offering the frameworks needed to curb the production of wastes and by encouraging the sustainable activities. This means that Waste Management Theory can be used as a basis for formulating powerful mechanisms to address the emerging problems of waste in an ever-urbanized world.

In addition to that, Waste Management Theory is fundamental in dealing with the threats of climate change especially as to production of hazardous and solid wastes. Proper waste management systems are also necessary in enhancing performance in revenue collection because they directly affect the sustainability and effectiveness of the waste disposal infrastructure (Chen et al., 2016). The rising waste with an added problem of climate change explains why there is a need to have new ways of managing waste which is more flexible to changes in environmental factors. This is coupled with the putting into place of policies that encourage recycling, reduction of the wastes, and safe disposal of a harmful substance (Pongrácz et al 2004). Through this improved practice in the management of waste, municipalities will not only have an opportunity to conserve the environment with regards to waste but also have an opportunity to perform better in their respective financial performance due to the improved revenue collection mechanism system.

The theory is significant to this study since it has been quite important in comprehending the mode of hazardous and solid waste production especially in the face of challenges of climate change. The theory that was utilized in this case underlines the influence of waste management practice on revenue collection performance. With climate change remaining to be a serious problem, proper management of waste is a prerequisite in the sustenance and enhancement of revenue streams (Pongrácz et al., 2004). Overall, the researcher used this theory to underpin the effect of generation of hazardous and solid waste on revenue collection performance in Rwanda.

2.1.3 Resources Depletion Theory

The Resource Depletion Theory (RDT) came into view in the 1990s with a critical work by Baumeister et al., in 1998, which offered empirical support to how a depleted-self-control would affect future performances in any other type of tasks (Chen et al., 2018). RDT, especially the aspect on self-control is in close connection with studies of Roy Baumeister and colleagues. According to Leahy and Sweller (2019), Theory of Resource Depletion or ego depletion is also closely connected with the studies of Roy Baumeister and his team. According to this theory, self-control, willpower or the executive function is used like a limited resource. This resource may get depleted as people get involved in a task that requires some self-control and are thus unable to display some level of self-control when entering into the execution of a following task.

The resource depletion theory notes that the excessive exploitation of natural sources should be regarded as extremely harmful to the sustainability of the environment and financial stability (Chen et al., 2018). The authors followed on to state that the theory about Resource depletion notes the rapid rate at which the natural resources are being utilized faster than they are able to be replaced thus leading to scarcity. Moreover, Asiedu et al. (2024) found that unsustainable extraction processes and consumption patterns are the leading factors of depletion. The consequences of this depletion are severe, answering to great economic, social and environmental outcomes that may affect both the communities and the ecosystems.

Further, it has been reported that Theory of Resource Depletion revealed some major impacts that have been as a result of over-mining and unsustainable exploitation of natural resources (Asiedu et al., 2024). The greater shortage of basic resources is also among the key consequences, which might result in a higher cost and economic pressure on people and states (Leahy & Sweller, 2019). Moreover, the effect on the environment is immense, which leads to the problems like deforestation and water pollution that contribute further to the ecosystem decline (Chen et al., 2018). These environmental problems also lead to social crises, with people having to contend with the effects of climate and the lack of resources and environmental destruction.

As Islam et al. (2023) point out, the resource depletion theory also illuminates the all-important connection between the drainage of natural resources and the problems of climate change, especially in connection with the work of revenue collection. With the continuing depletion of natural resources because of over-utilization and environmental deterioration, governments are experiencing huge challenges in balancing stable revenues (Chen et al., 2018). It does not only cause a reduction in the resources but also has consequences on the stability and growth of the economy as well as a possibility of a decline in government spending and investment. In addition to that, Asiedu et al. (2024) stated that the given theory highlights the importance of implementing sustainable management practices as a means of diminishing the negative consequences of resource depletion. Governments can strengthen the existing revenue collection capacity and mitigate the climate change effects by implementing the measures that focus on conservation and utilizing the existing resources efficiently (Leahy & Sweller, 2019).

The Resource Depletion Theory is important to this study because it is informative of how the depletion of natural resources influences the functioning of revenue collection. This is a theory, which points at the fact that reducing supply of natural resources can impair the capacity of a government to raise revenue. The researcher has also applied

this theory in explaining how depletion of natural resources has influenced the performance of revenue collection in Rwanda.

2.2 Empirical Review

2.2.1 Biodiversity Loss and Revenue Collection Performance

According to Shin et al. (2022), most measures to stop the loss of biodiversity are usually advantageous to the climate. The research paper explains how closely related climate change and biodiversity loss are and in what way these two environmental pressures are some of the most pressing that humanity has to deal with. It determines conservation measures where a large potential exists with climate change mitigation and points to the fact that the vast amount of conservation measures are not antagonistic trade-offs but synergistic. In particular, it states that 14 of 21 targets on the draft post-2020 global biodiversity framework have explicit climate change mitigation co-benefits. Moreover, it is possible to say that relations between biodiversity conservation and climate change are context and scale-specific, which implies that local conservation may be effectively coordinated with global goals. The report was confined to climatic change and loss of biodiversity.

Additionally, Aubert (2024) researched to determine the role of the tax systems in coordinating the governmental policies and the functions of the private sector with the aim of protecting biodiversity. The reading touches on the benefits of having proper taxation policy to encourage sustainable behavior in business entities and citizens, thus advancing biodiversity. The author outlines several measures that can be used in order to carry out tax reforms in support of the goals of biodiversity, which include incentive taxes being given to the conservation work as well as penalties to be imposed on activities that are harmful to the environment. It can be concluded that the results indicate that a tax regime that is constructed with biodiversity in mind can result in dramatic improvements in environmental results besides promoting economic growth. This covers the controversies and difficulties that reforming taxation systems have had in serving biodiversity interests. Tax systems, policies of the governments, and the activity of the private sector aimed at the conservation of biodiversity were considered as study subjects.

In a study by Lin and Song (2025), the correlation between biodiversity risk (BDR) and corporate tax avoidance (CTA) within the US company is identified to show significant results in a new manner. It shows that negative BDR makes firms prone to committing tax avoidance especially to face the liquidity demands. This drama is mainly powered by long-term risks of climate disasters which, combined with other risks, shape the approach of corporations towards taxes. The study showed that the negative BDR-exposed companies prefer to evade taxes when there is a heightened economic policy uncertainty in states. This uncertainty in the economic policy introduces friction, which will have marginal direct effects on CTA. The impacts of BDR are particularly keen in the firm where access to credit is low, financial performance lower, decreased liquidity positions, and payment outperformed, and opportunities to increase investments as suggested by the market-to-book value. The paper was based on greenhouse gas exposure, long-term climate change dangers, corporate actions and biodiversity extinctions.

2.2.2 Generation of Hazardous and Solid Waste and Revenue Collection Performance

By examining solid waste monitoring and revenue generating systems, Owusu-Banahene et al. (2021) observed that all the sources of waste are diverse such as domestic, commercial, industrial, and agricultural. Untreated waste can greatly destroy the environment and exhaust human resources. Despite the fact that numerous waste management companies have implemented systems to deal with these concerns there arises an urgent need to implement systems.

In addition, revenue collection is posing a problem and, in most cases, it is done on a manual basis where colleagues are hired to collect revenue. An Internet of Things (IoT) based system has been devised in order to address those issues to improve waste monitoring and revenue management. The research paper explained that the innovative system is a solution that uses ultrasonic sensors to detect the waste level after which the obtained information is posted to a server using a wireless mobile network automatically. The survey was founded based on the system of solid waste monitoring and generation of revenue.

The study conducted by Mensah et al. (2023) addressed the nature of waste businesses and waste management systems (WMS) performance in four provinces of Western Canada during the 16-year period. It brings out a salient gap in the available research in such areas. The results indicated that the average number of employees in waste businesses in Canada is between 13.4 to 22.1 employees with greater firms recording in jurisdictions with lower waste disposal rate. The waste under the management of each employee ranges between 1,098 to 1,426 tons in a year and this can mean that the more the employee numbers the better will be the sustainability of WMS in Canada. The paper presents considerable transfer of waste expenses which reaches the level of 12.76 billion dollars a year or about 40.7 percent of the total amount of waste management losses financed by the government. It is worth mentioning that only 2.5 percent of the budget in British Columbia (BC) is spent on managing recycling sites, and it has received the highest diversion rate of the waste.

The study by Kurniawan et al. (2024) analysed unlocked synergies between waste management and climate change mitigation to speed up the decarbonization process in Indonesia using circular-economy digitalization. The

research shows that Lombok Island, a tourist attraction site in Indonesia, presents a serious problem concerning solid waste management in the country, where about 600 metric tons of waste are produced in a day and 40 percent of them are non-biodegradable. The research questions examine how the both islands have been able to live with the challenge and the opportunity posed by digitalization within the context of a circular economy and the socio-economic interval of digital waste recycling. The research results infer that the digital revolution has been a blessing to different fields including the waste management in Hainan as the act of digitalization has resulted in a fantastic cut of 90 percent in waste production. It included the research on the possibility of decarbonization in the waste industry of Lombok with the help of circular-economy digitalization.

2.2.3 Natural Resource Depletion and Revenue Collection Performance

Radzuan et al. (2022) researched the effects of addressing the problem of natural resources depilation and a decrease of revenues by diversifying. The research showed the positive effect of the export of hydrocarbons on Brunei Darussalam and the fact that it has managed to escape the traps of the resource curse and the Dutch disease. Nonetheless, it has recognized the fact that Brunei remains exposed to fluctuations in the prices of oil and gas, which have a major impact on the economies of the hydrocarbon dependants in spite of the futures markets as the risk dampener. The problem with the depletion of resources and the instability of markets is compounded by the scantiness of non-hydrocarbon tradable activities. The paper notes three high-tech areas that might shape up the industrial policy of Brunei namely semi-conductors and fiber optics, hi-tech farming and hi manufacturing. Such industries are regarded to be critical towards achieving economic robustness and sustainability against the indexing hydrocarbon income. The research did not venture into addressing the aspects of natural resource exploitation and revenue reduction related to diversification.

The question by Azwardi et al. (2022) was about the environmental effects of natural resources depletion. The paper submitted in the International Conference on Indonesian Architecture and Planning studies the crucial environmental effects that have been caused as a result of the exhaustion of natural resources. The authors stress that an excessive number of resources extracted results in the negative impact on the ecosystem, biodiversity, and the whole environment. They also point out the necessity of a sustainable management approach to preempt these impacts to preserve the natural resource to the future generation. The paper also supports the view that resource depletion and environmental degradation are linked together in that when managing natural resources, we should take into account the environmental factors. The authors of the study dedicated their research to environmental issues and exhaustion of natural resources.

Asiedu et al. (2024) discussed how depletion of natural resources influenced vulnerability of climate change and income inequalities. It points at the twofold difficulty Africa has in coping with the proliferation of its natural resources in the face of climatic change and social and economic inequality. It enquires how the phenomenon of the natural resource depletion contributes to the climate change vulnerability and the issue of income inequality in 21 countries of Africa, employing the Method of Moments Quantile Regression (MMQR). The results show that there is a significant positive correlation between natural resource depletion and vulnerability to climate change and between depletion of the resources and income inequality and again this shows that depletion of the resources increases these and thus worsens the situation. It underlines that sustainability in the management of resources should consider sound climate change prevention methods and policies and take into consideration the environmental and equity aspect. The research dealt with depletion of natural resources, vulnerability to climate change and income inequalities.

III. METHODOLOGY

3.1 Research Design

The research utilized a descriptive research design to gather data through questionnaire. This approach is straightforward and aims to collect information from members of the population, focusing on the existing phenomena related to the effect of climate change challenges on revenue collection performance in Rwanda. Additionally, the study incorporated a correlation research design to explore the relationship between climate change challenges and revenue collection performance in Rwanda.

3.2 Population

The study population consists of 791 employees from various departments within the RRA, including custom services department (386), IT and digital transformational department (89), Strategic intelligence and investigation division (42), Taxpayer services and communication division (49), Planning, research and statistics department (28), Tax control and operational support division (63), Registration, filing and payment division (87), and Compliance risk analysis and data analytics division (47). This demographic is crucial for the researcher's analysis and conclusions.

3.3. Sample Size and Sampling Technique

This study used the Yamane Taro formula for sample size determination. It provides a systematic approach to determining the appropriate number of respondents needed for this study.

$$n = \frac{N}{1 + N(e)^2}$$

Where n: sample
N: population
(e): sampling error =10%

where e is the degree of accuracy, n is the sample size, and N is the population size.

$$n = \frac{791}{1+791(0.1)^2} = 88.77$$

n=89 respondents

This study employed simple random sampling where each member of this population has an equal chance of being selected. The sample size of this study was 89 respondents from the RRA staff. Every respondent in the RRA database from 1 to 791, the researcher used a random number generator to select 89 respondents. On the other hand, stratified sampling involved dividing the population into distinct strata based on their departments.

This ensures that each department is adequately represented in the sample. The strata of population in this study were (Stratum one: custom services department 43(48.8%), Stratum two: IT and digital transformational department 10(11.3%), Stratum three: Strategic intelligence and investigation division 5(5.3%), Stratum four: Taxpayer services and communication division 6(6.3%), Stratum five: Planning, research and statistics department 3(3.6%), Stratum six: Tax control and operational support division 7(7.9%), Stratum seven: Registration, filing and payment division 10(10.9%), Stratum eight: Compliance risk analysis and data analytics division 5(5.9%).

3.3 Research Instruments

This paper employed the primary tools that included a questionnaire. In the review of the documentary, different sources were carefully studied such as books, reports, scholarly articles, online documents, research projects, and websites. The choice of these sources has been predetermined by the accessibility and its applicability to the study subject. Moreover, the questionnaire would be divided into two parts. Section A obtained demographical data of the respondents such as identity, age, sex and years of experience. Section B concentrated on major study themes where specific questions with the aim of collecting quantitative data were present. The respondents were asked to rate their agreement with a Likert scale of one (1) labeled with Strongly Disagree to 5 labeled with Incredibly Agree. This tool was designed to determine how the challenges posed by climate change have affected revenue collections in the Rwanda country. The data were collected in RRA from 89 respondents.

3.4 Data Analysis Methods

Tabulation, editing, and coding were used in analyzing the data by spreading the data and making them clear and understandable. Further, the research method adopted in this study was quantitative because it used descriptive as well as inferential statistics to interpret findings. Descriptive statistics were done to calculate the mean and standard deviation.

The average level of agreement that was created between respondents was measured by the mean whereas the standard deviation was applied to determine the extent to which the opinions of the respondents were different and locate the extent to which it was homogeneous or heterogeneous. Additionally, mean was expressed in the form of five-point Likert rating scale that entailed the range of means and their verbal descriptions, Knowledge, Attitude, and Practice (KAP) analysis. The scale scores are divided into five classes as; a mean of between 0.01 and 1.00 measures a level of knowledge, attitude or practice that is termed as a very low level; 1.01-2.00 constitutes a low level, 2.01-3.00 a moderate level, 3.01-4.00 a high level and 4.01-5.00 a very high level of knowledge, attitude or practice. Moreover, data consistency analysis was carried out based on the standard deviation as an important methodological tool. A standard deviation of 0.5 or less meant that there was a homogenous collection of responses and when the deviation is greater than 0.5 then responses are heterogeneous.

IV. FINDINGS & DISCUSSION

4.1 Response Rate

This section is related to the presentation of findings, analysis and interpretation of findings. It is founded on certain aims like to determine the impact of loss of biodiversity on the performance of revenue collection in Rwanda, to determine the impact of generation of hazardous and solid waste on the performance of revenue collection in Rwanda and to determine the impact of natural resource depletion on the performance of revenue collection in Rwanda.

Table 1

Response Rate

Response Rate	Frequency	Percent
Returned and complete	89	100.0
Returned and incomplete	0	0.0
Unreturned	0	0.0
Total	**89**	**100.0**

In Table 1, it is indicated that 89 questionnaires were distributed to the respondents and a total of 89 questionnaires had been filled, handed back and complete, and this represents 100.0 percent of the respondents. All the questionnaires were filled by the respondents. This was accomplished since the researcher briefed the respondents who had hard time filling in the questionnaires about the significance of the study and demonstrated on how to fill in the questionnaires to them.

Table 2

Gender of Respondents

Gender	Frequency	Percent
Male	38	42.7
Female	51	57.3
Total	**89**	**100.0**

Table 2 indicates the results regarding the distribution of the participations by gender. The two gender groups have 57.3 percent of the female respondents and 42.7 percent of the male respondents respectively, out of 89 respondents. It would be necessary to acknowledge the gender distinction between the respondents which could reveal the possible differences in the views and offer the answers to climate change issues and the effectiveness of the revenue collection.

Table 3

Age Group of Respondents

Age Group	Frequency	Percent
Between 18-30 years	10	11.2
Between 31-40 years	34	38.2
Between 41-50 years	33	37.1
51 years and above	12	13.5
Total	**89**	**100.0**

Table 3 shows the findings about the age group of respondents. Out of 89 respondents, the majority (38.2%) of respondents is aged between 31-40 years, 37.1% aged between 41-50 years, 13.5% aged 51 years and above, and 11.2% aged between 18-30 years. Age is a critical factor in this study as people's knowledge, behaviors and aptitudes evolve with age.

Table 4

Education Level of Respondents

Education Level	Frequency	Percent
Bachelor	54	60.7
Master	32	36.0
PhD	3	3.3
Total	**89**	**100.0**

The distribution of educational levels of the respondents utilized as RRA staff is represented in table 4. The research defines that 60.7 percent of 89 respondents are under the education level to bachelor, 36. 0 percent under master and 3. 3 percent under PhD. Educational background is varied and most have bachelor's degrees as a form of education. This potentially augments the capacity to understand the complex relationship that exists between the challenges of climate change and the performance in revenue collections.

Table 5

Work Experience of Respondents

Work Experience	Frequency	Percent
Less than 2 years	15	16.9
Between 3-6 years	31	34.8
Between 7-10 years	23	25.8
Between 11-15 years	17	19.1
16 years and above	3	3.4
Total	**89**	**100.0**

Table 5 concerns the results of work experience distribution of the respondents. To assess the number of years of work experience, the data in relation to the 89 respondents reveal that 16.9 percent of the respondents have less than 2 years of work experience, 34.8 percent of the respondents have between 3-6 years of work experience, 25.8 percent of the respondents have 7-10 years of work experience, 19.1 percent of the respondents have 11-15 years professional background and only 3.4 percent of the respondents have 16 years and above. Most of them (3-6 years professional background). The levels of work experience provided by various people in the team offer a possibility of having a balanced staff, with expertise to aid togetherness and creativity with regards to issues of climate changes and collection of revenue.

4.2 Descriptive Statistics

Mean and standard deviation was used to depict the distribution of the Likert scale rating of respondents on different propositions. The section follows specific objectives, that is, to determine the influence of erosion of biodiversity production of hazardous and solid wastes depletion of natural resources on revenue collection performance in Rwanda and determine the revenue collection performance in Rwanda.

Table 6

Effect of Loss of Biodiversity on Revenue Collection Performance

Statement	Mean	Std. Dev.
Lower fish catches mean reduced sales and therefore lower tax revenues collected from fish sales	4.18	.762
Declining wildlife population, tourist numbers is dropped, impacting park entrance fees, accommodation bookings, tour guidance services, and other related business	4.04	.916
Lower agricultural output decreases the income of farmers and related businesses, leading to lower tax revenue for governments	4.10	1.056
Reduced agricultural production leads to higher food prices, potential affecting consumer spending	4.24	.879
Overall	**4.14**	**0.903**

Table 6 gives the result regarding the effect of loss of biodiversity on revenue collection performance with regard to descriptive statistics. The respondents all agreed that the low fish catch is correlated to low fish sales and consequently a low tax revenue collected on the fish sales, which is marked with a very high mean score of 4.18, indicate that very formidable positive agreement among the respondents. The value of the standard deviation, 0.762, however, shows that there were heterogeneous responses during the research.

Moreover, there is a very high mean score of 4.04, and this implies that the level of positive agreement among the participants of the survey held is very strong. But the standard deviation of 0.916 indicates that there was a fluctuation in the answers. In addition, the respondents also pointed out that there is an extremely high positive opinion with an extremely high mean of (M=4.10) associated with the statement that less agricultural productivity would translate into dwindled revenues of the farmers and other businesses to generate reduced taxes revenue to governments. A standard deviation of 1.056 depicts the different responses held by respondents.

The statement that lesser farming yields will translate to higher food prices with possible impact on consumer expenditure, the score of 4.24 is acutely high as it is the level at which there is an eminent consistency of positive agreement amongst the participants. But, some heterogeneity in opinions is marked by the standard deviation of 0.879.

The general very strong positive mean of 4.14 of combined statements shows on overall very strong positive agreement that there is effect of biodiversity loss on revenue collection performance, and a standard deviation of 0.903, signifies some difference of responses among the respondents. The results correspond to those of Shin et al. (2022) which documents the dire relationship between climate change and the loss of biodiversity through the lenses of one of the greatest environmental issues mankind currently faces. Along with that, Aubert (2024) specified the use of tax schemes to balance between government policy and participation by the private sector to biodiversity preservation objectives. The paper explains that sustainable business and individual practice may be encouraged through the use of effective policies to enhance biodiversity. Besides, Shin et al. (2022) examined the correlation between the biodiversity

risk and corporate tax avoidance in US companies and made important discoveries on that matter, highlighting it for the first time. It also indicates that companies that are in adverse biodiversity stands are prone to avoidance, especially to cope with liquidity requirements.

Table 7

Effect of Generation of Hazardous and Solid Waste and Revenue Collection Performance

Statement	Mean	Std. Dev.
Unmanaged waste, especially in tourist areas, can create an unpleasant environment, deterring visitors and impacting tourism revenue	3.93	1.064
Poor waste management results in increased incidence of illnesses, leading to increased healthcare costs	4.81	.655
Poor waste management damage infrastructure leads to business disruptions	3.96	.976
Areas with poor waste management practices is less attractive to investors	4.12	.823
Overall	**4.20**	**.879**

Table 7 indicates the descriptive analysis result on the effect of generation of hazardous and solid waste and performance on revenue collection. Many respondents agreed to the sentence in which they said unmanaged garbage particularly in tourist regions may induce an uncomfortable surrounding and drive people away with a corresponding high mean of 3.93 (SD=1.064) and the standard deviation that shows the diversity of opinions.

Also, the respondents agreed that the poor nature of waste management causes more people to be infected with diseases involving higher medical costs which has a very higher mean (SD= 0.655) indicating that the opinion was very high in regards to all who participated in the survey.

Additionally, a high average score of 3.96 (SD=0.976) is established in the perception that poor waste management destroys infrastructures and causes business interruptions. This shows that there was a high level of agreement and the agreement was high among or between participants. The standard deviation implies that there is a variation that questions multiple views by the participants. In the statement whereby the region with meager waste management practices is not preferable to investors, the mean score of 4.12 shows high strong agreement demonstrating that there is a very high degree of positive agreement but the standard deviation of 0.823 indicates that the responses are heterogeneous.

The very high mean of 4.20 in the generalized fitness of the blended statements indicates an overall very strong positive response to the existence of an influence of generation of hazardous and solid waste and the performance of revenue collection and with a standard deviation of 0.879 it has a little variability in views. The results are consistent with those of another study by Owusu-Banahene et al. (2021) which revealed that a source of waste is differentiated into domestic, commercial, industrial and agricultural sources. In the absence of its management, waste is likely to severely damage the environment and drain human resources. Also, problems in the collection of revenue are a reality such that the collection of revenue is at times being done by agents on a manual collecting system. Furthermore, the study by Mensah et al. (2023) was devoted to the study of the nature of waste businesses and the functioning of waste management systems (WMS) in four western Canadian provinces over the period of 16 years. It finds that there is a significant lack in the research that is already conducted in these respects. The research reveals high expenditures of transfer of wastes, as it is at the rate of 1276 million dollars per year that is about 40.7 percent of money the government spends annually on waste management.

Table 8

Effect of Natural Resources Depletion and Revenue Collection Performance

Statement	Mean	Std. Dev.
Soil degradation caused by pollutants results in decreased tax revenues and other forms of government revenue collection, due to the negative impact on various economic sectors	4.06	1.059
Industries like timber, tourism, and non-timber forest products suffer forms the loss of forest resources, resulting in decreased tax revenue	4.16	.987
Resource depletion directly reduces the quantity of resources available for extraction, leading to a decline in related tax revenues	3.82	1.103
Increased costs reduce the profitability of resource extraction, leading to lower tax revenues for government	3.89	1.133
Overall	**3.98**	**1.070**

Table 8 shows the findings about the effect of natural resources depletion and revenue collection performance on revenue collection performance. The respondents agreed that soil degradation caused by pollutants results in decreased tax revenues and other forms of government revenue collection, due to the negative impact on various

economic sectors, designated by a very high mean score of 4.08, signifies that very strong positive agreement among participants. However, the standard deviation of 1.059 indicates the heterogeneity in responses among participants.

Furthermore, the respondents indicate a very strong consensus regarding the industries like timber, tourism, and non-timber forest products that suffer from the loss of forest resources, resulting in decreased tax revenue, reflected in a very high mean score of 4.16. This score suggests a very strong positive agreement among participants. However, the standard deviation of 0.987 points to a variability in the responses.

Moreover, the participants noted there are strong positive opinions with a high mean score of (M=3.82) for the statement that resource depletion directly reduces the quantity of resources available for extraction, leading to a decline in related tax revenues, leading to lower tax revenue for governments. The standard deviation of 1.103 signifies the diverse opinions in responses among respondents. The high men score of 3.89 for the statement that increased costs reduce the profitability of resource extraction, leading to lower tax revenues for the government designates a high level of positive agreement among participants. However, the standard deviation of 1.133 highlights some heterogeneity in opinions.

The general high mean of 3.98 on compounded statements depict the general strong positive consensus that there is an impact of depletion of natural resources on the performance in revenue collection performances with a standard deviation of 1070 depicts some discrimination in responses among participants. The results are consistent with the research undertaken by Radzuan et al. (2022) investigated the issue of addressing the depletion of natural resources and the loss of revenue through diversity. The paper has given insight into the fact that despite the hydrocarbon export being started in Brunei Darussalam, the country has not been majorly affected by the drawbacks of the resource curse and the Dutch disease. Moreover, Azwardi et al. (2022) researched on the effect of the depletion of natural resources on the environment. The research paper that shall be presented at the International Conference on Indonesian Architecture and Planning is concerned with the impact of environmental effects that are induced through demolition of the natural resources. The authors point out that over-exploitation of natural resources is associated with the negative consequences to ecosystems, biodiversity as well as to the overall environmental health. In addition, the study of Asiedu et al. (2024) investigated the effects of depletion of natural resources on the vulnerability to climate change and income inequalities.

Table 9

Performance of Revenue Collection

Statement	Mean	Std. Dev.
Biodiversity loss reduces the revenue collection performance	4.20	.881
Generation of hazardous and solid waste reduce the revenue collection performance	4.27	.863
Natural resource depletion reduces the revenue collection performance	4.34	.852
Challenges of climate change reduce the revenue collection performance	4.34	.783
Overall	**4.28**	**.844**

The results presented in Table 9 are regarding the descriptive statistics of the revenue collection performance. Respondents all supported the fact that the loss of biodiversity hinders the performance of revenue collection, assigned to a very high mean mark of 4.20, which indicates that very strong positive cooperation of the respondents involved. But the standard deviation proves that the responses vary among the respondents, not being homogenous; it is marked with 0.881.

Moreover, the respondents respond with very strong agreement as to the effect of generation of hazardous and solid waste on the performance of revenue delivery, with a very high mean score of 4.27 this would imply a very strong positive agreement among the respondent. Nonetheless, there is standard deviation of 0.863, which means that the responses are not standard and individual opinion may vary much.

In addition, the alumni observed that in the statement that depletion of natural resources lowers the revenue collection performance there are very strong positive opinions of a very high crude score of (M=4.34). The standard deviation of 0.852 indicates that there were opinions differences in the answer of respondents. The 4.34 point very high men score of the statement that challenges of climate change reduce the revenue collection performance designates as very high the level of positive agreement by the participants. There is, however, a certain heterogeneity in opinions as shown by SD of 0.783.

The very high overall mean of 4.28 of combined statements signifies overall very strong positive agreement that there is an effect of the challenges of climate change on the performance of revenue collection with standard deviation of 0.844 is a measurement of some variety in responses by respondents. The results have also been supported by research studies carried out by Kitavi (2023), which have concluded that the performance of revenue collection depends much on several factors such as conditions of economic activity, climatic change situations, taxation policy, and working efficiency of administration. Moreover, Hagenimana and Niyibizi (2022) have stated that tax policies are also instrumental in determining the revenue outcome.

Table 10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.851[a]	.725	.715	.36922

a. Predictors: (Constant), Generation of hazardous and solid waste, Natural resources depletion, Loss of biodiversity

The Model Summary of the regression analysis is found in Table 10. The R value of 0.851 shows that there is a lengthy positive connection between the predictors (loss of biodiversity, generation of hazardous and solid waste and depletion of natural resources) and dependent variables (revenue collection performance). The R Square value at 0.725 indicated that about 72.5 percent of the variability in the performance of revenue collection in Rwanda would be accounted for by independent variables in the model. Khan et al., (2021) asserted that the disruption results in a decrease in the revenue-generating activities on the part of governments as climatic-based disasters may cause subsequent challenges to business operations or lead to business closure. Also, climate change may increase existing inequality, as vulnerable groups will be impacted with bias. This may lead to reduction of compliance with tax paying, seeing that the most affected people would give a higher consideration towards survival at the moment, as opposed to paying tax.

Table 11

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.481	3	10.160	74.531	.000[b]
	Residual	11.588	86	.134		
	Total	42.069	89			

a. Dependent Variable: Revenue collection performance

b. Predictors: (Constant), Generation of hazardous and solid waste, Natural resources depletion, Loss of biodiversity

The Analysis of Variance (ANOVA) results in Table 11 indicates a highly significant F-statistic of 74.531 (p = 0.000). The F-statistic assesses the overall significance of the regression model, testing whether there is a significant difference between the model with predictors (loss of biodiversity, production of hazardous and solid waste and natural resource depletion) and dependent variables as revenue collection performance. In this case, the small p-value (p = 0.000< 0.05) associated with the F-statistic indicates that the predictors jointly have a significant effect on explaining the variance in the dependent variable (Revenue collection performance). The same is justified by Khan et al., (2021) who stated that the disturbance causes a reduction in the ability of governments to generate revenue, because businesses might incur costs or even close their doors because of the climate-related disasters. Also, climate change may fuel inequalities that already exist in the population and seriously harm vulnerable groups. This can lead to fall in compliance with taxes since people who are likely to be hit hardest might decide to think on how they can survive in the short-term as opposed to paying taxes. Additionally, Hagenimana and Niyibizi (2022) added that tax policies play a crucial role in shaping revenue outcomes. Effective tax structures that are equitable and easy to comply with can enhance collection rates, while overly complex or burdensome systems may lead to evasion and lower compliance. Additionally, the efficiency of tax administration, including the capacity to enforce compliance and manage collections, directly affects revenue performance.

Table 12

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.562	.278		2.019	.047
	Loss of biodiversity	.512	.070	.572	7.314	.000
	Natural resources depletion	.074	.052	.085	1.423	.160
	Generation of hazardous and solid waste	.312	.078	.315	4.000	.000

a. Dependent Variable: Revenue collection performance

Table 12 presents the values of the coefficients of the regression model that predicts the performance of revenue collection using the predictors (loss of biodiversity, generation of hazardous and solid waste and natural resource depletion) and a dependent variable (revenue collection performance). The constant is 0.562 and the standard error is 0.278 (p=0.047). In reference to the predictors, two predictors have a positive and statistically significant effect on the

performance of revenue collection in Rwanda whereas one predictor has positive association and statistically they have no significant effect on the performance of revenue collection in Rwanda.

The loss of biodiversity exhibits a positive relationship with a reduction of 0.512 units in the performance of revenue collection in Rwanda when there is a unit increment of the loss of biodiversity. Nonetheless, H01 The effect of loss of biodiversity is not significant in the revenue collection performance of Rwanda hence this hypothesis is rejected since the p=0.000 is less than 0.05. These results correspond with Khan et al. (2021) who mentioned that the loss of biodiversity has far and broad impacts on the ecosystems, human health, and the economy. This results in more vulnerability of ecosystems with environmental alterations and calamities. Weakened resilience leads to the more severe effects of climate change, including flooding and droughts, and this aggravates the problems experienced not only by people but also by wildlife. Shin et al. (2022) also noted that the loss of biodiversity also threatens human health because it can give rise to the development of new diseases and degradation of pharmaceutical resources.

For every-unit increase in the generation of hazardous and solid waste, there is a 0.312 unit decrease in the dependent variable (performance of revenue collection in Rwanda). However, the null hypothesis that H02 There is no significant effect of generation of hazardous and solid waste on revenue collection performance in Rwanda, therefore, this hypothesis is rejected because the p=0.000 which is less than 0.05.

The findings are supported by Kurniawan et al. (2024) stating that the escalating recognition of hazardous and solid waste generation as a significant challenge in the context of climate change. It emphasizes that the generation of waste products is of significant threat to human health and to the environment especially amid the growing rates and intensity of climate-related incidents. Besides, Islam et al. (2023) noted that they report that inappropriate waste disposal is recognized as a relevant factor in the emission of greenhouse gases that worsen the existing climate change problems. This highlights the pressing importance of proper waste management measures that can minimize the risks and deal with the overall consequences of waste production in relation to climate processes.

Besides, the depletion in natural resources has an optimistic effect where 0.074 unit decrease in the dependent variable (performance of revenue collection in Rwanda) is associated with every unit increase in natural resource depletion. But the null hypothesis that H03 the effect of natural resource depletion to revenue collection performance in Rwanda is not significant therefore, this hypothesis would be accepted since p=0.160 that is more than 0.05. The results can be said to agree with Huynh and Hoang (2025), who indicated that revenue collection performance is directly related to the wellbeing of natural resources. The sustainable management of the natural resources helps in preserving the revenue sources and stabilizing the economy especially in various regions where the natural resources are the basic economy. According to Azwardi et al. (2022), the depletion of natural resources, especially the soil that is damaged by toxicants has immense economic effects, which include loss of tax revenues and government revenue collection. This was mainly because of the negative implications that affect different sectors of the economy such as timber, tourism as well as non-timber forest products which are faced with the loss of forest assets.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This study examines how challenges of climate change affect the level of revenue collection performance of Rwanda based on three areas: loss of biodiversity, production of hazardous and solid waste, and depletion of natural resources. These results show that climate change issues have a major impact on the performance of the revenue collection in the nation. Concerning biodiversity loss, strong positive correlation among the respondents on the impact to revenue collection performance is evident based on high mean value and standard deviation representing diversity in the responses. This implies that biodiversity loss is an important aspect that contributes to revenue collection in Rwanda. Also, the impact of the hazardous and solid waste generation depicts a high positive agreement level with strong means indicating that the respondents were quite consistent in their opinions. The fact that the responses were characterised by large variability as demonstrated by the standard deviation lends further weight to the significance of this problem. The last dimension concerns the evaluation of natural resource depletion that reveals prominent positive concordance with its consequences on revenue collection performance with a high average and a high variance of the responses. This reconfirms the finding that shortage of natural resources is another major problem that is influencing the revenue collection in Rwanda. In general, the study reveals the interrelationship between climate change challenges and performance in the collection of revenue in Rwanda indicating that strategic undertakings must be put in place to alleviate these environmental challenges.

5.2 Recommendations

This study investigates the effect of challenges of climate change on revenue collection performance. The specific objectives were to assess the effect of loss of biodiversity on revenue collection performance in Rwanda, to evaluate the effect of generation of hazardous and solid waste on revenue collection performance in Rwanda and to evaluate the effect of natural resource depletion on revenue collection performance in Rwanda.

The study examines the effect of biodiversity loss on revenue collection performance in Rwanda. Thus, the study concludes that loss of biodiversity affects the performance of revenue collection in Rwanda, hence, the study recommends the need for tax managers to integrate biodiversity considerations into their revenue strategies. Additionally, the study evaluates the effect of hazardous and solid waste generation on revenue collection performance in Rwanda. Hence, the study concludes that there is an effect of generation of hazardous and solid waste on revenue collection performance, therefore, the study highlights the need for tax managers to adopt effective strategies to enhance revenue collection amidst the challenges posed by waste management. Further, the study assesses the effect of natural resource depletion on revenue collection performance in Rwanda. Thus, the study concludes that natural resource depletion affects the performance of revenue collection. As natural resources diminish, the potential for revenue collection also declines, which can adversely affect the country's economic stability.

Based on these conclusions and findings, the study recommends that:

-RRA should develop revenue streams from eco-friendly industries by supporting and taxing businesses engaged in renewable energy, sustainable agriculture, and eco-tourism. The RRA could provide incentives such as tax breaks or streamlined licensing for businesses that demonstrate strong environmental performance.

-RRA should enforce environmental regulations in collaboration with the Rwanda Environment Management Authority (REMA), ensuring compliance through monitoring, auditing, and imposing penalties for violations.

-RRA should promote green public procurement which is also vital, as prioritizing environmentally friendly products and services in government purchases can stimulate demand for sustainable goods and encourage businesses to adopt more sustainable practices.

-RRA integrates environmental considerations into tax policy, such as implementing carbon taxation and providing tax breaks for environmentally friendly investments. Finally, strengthening institutional cooperation among government agencies, including REMA and the Ministry of Finance and Economic Planning, is crucial for a coordinated approach to environmental sustainability and revenue generation.

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