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Overview on the institutions, laws, policies and programs contributing on air pollution prevention in Rwanda

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Abstract

This paper explores the institutions, laws, policies, and programs contributing to air pollution prevention in Rwanda. It examines the various initiatives implemented by the Rwandan Government and other stakeholders to mitigate the impact of air pollution on public health and the environment. The study highlights the importance of effective governance structures, regulatory frameworks, and sustainable development strategies in addressing air pollution challenges in Rwanda. By analysing the key institutions, signed international conventions, protocols and treaties, laws, policies, and programs aimed at reducing air pollution in the country, this paper provides valuable insights into Rwanda's efforts to promote environmental sustainability and public health.

Key words: Environment, Air pollution, Environmental sustainability, Public health

1. INTRODUCTION

Rwanda is committed to protecting the environment and addressing climate change. It has a vision to be a climate resilient and carbon neutral economy by 2050 (Republic of Rwanda, 2020). The country is working to achieve its 2030 goal of reducing emissions by 38% by engaging with partners, both

nationally and internationally, to attract sustainable green investment (Republic of Rwanda, 2022). For effective environmental management, protection and mitigation, the Government of Rwanda established various institutions with specific mission assigned to each of them. Those institutions provide the good opportunities of cooperation between political actors and environmental officers for sustainable development. In the same perspective, a number of conventions, protocols, treaties and agreements were signed by the Government of Rwanda (REMA, 2014). Laws, policies and programs are among privileged tools for the achievement of vision 2050 and sustainable development (Republic of Rwanda, 2020). The objective of this paper is to have an overview and provide the general information about institutions, signed international conventions, protocols and treaties, laws, policies and programs contributing on air pollution prevention in Rwanda. The specific research questions we sought to answer were the following:

- A. What are the institutions contributing to air pollution prevention in Rwanda?
- B. Which international conventions, protocols, treaties and agreements related to air pollution prevention signed by the Government of Rwanda?
- C. What are laws, orders, policies and programs established in Rwanda for air pollution prevention?

2. METHODOLOGY

This systematic review applied the SALSA Framework process. According to Grant and Booth (2009), the SALSA (Seach, Appraisal, Synthesis, and Analysis) method has four basic steps: search (define searching string and types of databases), appraisal (pre-defined literature inclusion and exclusion, and quality assessment criteria), synthesis (extract and categorize the data), and analysis (narrate the result and finally reach into conclusion). Practically, this overview has taken an in depth look at existing institutions, conventions, protocols, treaties, laws, policies, programs and associated documents. The data and information about considered institutions, conventions, protocols, treaties, laws, policies and programs were obtained from websites and offices of concerned institutions. The appraisal was done based on pre-established quality assessment criteria, such as the linkage between the institution's mission and activities, convention, protocol, treaty, law, policy or program and air pollution prevention. Therefore, content analysis was utilized to classify the reviewed institutions' missions and activities, convention, protocol, treaty, law, policy and program. Holsti (1969) stipulates that content analysis is a "technique for making inferences by objectively and systematically identifying specified characteristics of messages". In that perspective, a particular focus was on the parts related to air pollution prevention during the content analysis. In addition, it has been often required to make contact

of key persons having deep information about institutions, conventions, protocols, treaties, policies and programs to complete information obtained from documents under review. Using the inclusion and exclusion criteria, a total of 5 public institutions and 2 categories of organisations, 10 international conventions, protocols, treaties and agreements, 3 laws, 1 ministerial order, 3 policies and 6 programs were considered for the overview.

3. FINDINGS AND DISCUSSION

3.1. Institutions contributing to air pollution prevention in Rwanda

In Rwanda, several institutions play a crucial role in the prevention of air pollution. These institutions are dedicated to implementing policies, conducting research, raising awareness, and promoting sustainable practices to reduce air pollution levels in the country. The mission of these institutions in Rwanda is aligned with national goals to improve air quality, protect public health, and preserve the environment for future generations. Their collective efforts aim to:

- develop and enforce policies that regulate emissions from industries, vehicles, and other sources of pollution (Ministry of Environment, 2019, REMA, 2018; Republic of Rwanda, 2022).
- monitor air quality through data collection, analysis, and reporting to identify pollution hotspots and trends (REMA, 2018; RURA, 2018; RBC, Republic of Rwanda, 2022; Ministry of Environment, 2019).
- Raise awareness among the public about the health impacts of air pollution and promote behavior changes that reduce emissions (Ministry of Health, 2015, Beaglehole et al, 2011; World Bank Group, 2019; World Health Organization, 2021).
- Support research initiatives that advance scientific knowledge on air quality management and mitigation strategies (Ministry of Health, 2015; United Nations Environment Programme, 2018).
- Collaborate with international partners to access technical expertise, funding opportunities, and best practices for sustainable development.

By working together towards these objectives, institutions in Rwanda contribute significantly to mitigating air pollution risks and creating a cleaner, healthier environment for all residents. Some of the key institutions contributing to air pollution prevention in Rwanda include:

1. **Ministry of Environment:** The Ministry of Environment in Rwanda is the key player in the efforts to prevent air pollution. It oversees the development and implementation of environmental policies and strategies, including those related to air quality monitoring, emissions control, and sustainable development. The ministry collaborates with various stakeholders to raise awareness about the importance of clean air and to implement measures to reduce pollution levels (Republic of Rwanda, 2019; Republic of Rwanda, 2022; REMA, 2018; REMA, 2022).

2. **Rwanda Environmental Management Authority (REMA):** REMA is the government institution responsible for coordinating all environmental management activities in Rwanda. It plays a significant role in formulating policies and regulations aimed at preventing air pollution and promoting environmental sustainability. REMA works closely with other government agencies, local communities, and international partners to address environmental challenges, including air pollution (Republic of Rwanda, 2013; Republic of Rwanda, 2019; Republic of Rwanda, 2022; REMA, 2018; REMA, 2022).
3. **Rwanda Green Fund (FONERWA):** FONERWA is a national fund that supports green projects aimed at promoting environmental sustainability in Rwanda. The fund invests in initiatives that reduce greenhouse gas emissions, improve air quality, and enhance climate resilience across various sectors (Republic of Rwanda, 2012; Ministry of Environment, 2019).
4. **Rwanda Utilities Regulatory Authority (RURA):** RURA is responsible for regulating utilities and ensuring compliance with environmental standards in Rwanda. As part of its mandate, RURA monitors industrial emissions, vehicle emissions, and other sources of air pollution to enforce regulations that limit harmful pollutants released into the atmosphere. By setting standards and conducting inspections, RURA contributes to the prevention of air pollution in the country (Republic of Rwanda, 2022; Republic of Rwanda, 2013).
5. **Rwanda Biomedical Center (RBC):** RBC is a public institution that focuses on improving public health outcomes in Rwanda (Republic of Rwanda, 2011). The center works on various health-related issues, including air pollution monitoring and management to protect the population from respiratory diseases and other health impacts associated with poor air quality (Ministry of Health, 2015; Ministry of Environment, 2019; Republic of Rwanda, 2022).
6. **Academic institutions:** Academic institutions also play a vital role in addressing environmental challenges, including air pollution. Researchers and students at the university conduct studies on air quality, pollution sources, and mitigation strategies to provide valuable insights for policymakers and stakeholders. The university's expertise contributes to evidence-based decision-making and innovative solutions for reducing air pollution in Rwanda (Ministry of Health, 2015; Ministry of Environment, 2019).
7. **Non-Governmental Organizations (NGOs):** Several NGOs operating in Rwanda focus on environmental conservation and sustainable development initiatives, including efforts to prevent air pollution. These organizations work on community engagement, advocacy campaigns, capacity building, and practical projects that promote clean air and healthy environments. By partnering

with local communities and government agencies, NGOs enhance the impact of air pollution prevention efforts across the country (Ministry of Environment, 2019; REMA,2022).

In summary, these institutions collaborate with government agencies, civil society groups, academia, and international partners to implement comprehensive strategies for air pollution prevention in Rwanda. Their missions revolve around promoting sustainable practices, raising awareness about the impacts of air pollution on public health and the environment, advocating for policy changes, and supporting innovative solutions to mitigate emissions and improve air quality across the country.

3.2. International conventions, protocols, treaties and agreements signed by the Government of Rwanda for air pollution prevention

The Government of Rwanda has been actively involved in international agreements and conventions aimed at preventing air pollution and promoting environmental sustainability. Some of the key international conventions, protocols, treaties, and agreements signed by Rwanda in this regard include:

1. **Kyoto Protocol:** The Kyoto Protocol is an international treaty that extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and commits state parties to reduce greenhouse gas emissions (BYJU'S, 2023; United Nations Climate Change, 2024). Rwanda signed the Kyoto Protocol on 10 June 1992 and ratified it on 18 August 1998. The entry into force of the protocol is from 16 November 1998 (United Nations, 2005).
2. **Paris Agreement:** The Paris Agreement is an international treaty under the UNFCCC that aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels (BYJU'S, 2023; Gupta et al., 2018; United Nations Climate Change, 2024). Rwanda signed the Paris Agreement on April 22, 2016, and ratified it on September 27, 2016 (United Nations Treaty Collections, 2024).
3. **Vienna Convention for the Protection of the Ozone Layer:** The Vienna Convention is a multilateral environmental agreement designed to protect the ozone layer by regulating the production and consumption of ozone-depleting substances (BYJU'S, 2023). Rwanda acceded to the Vienna Convention on October 11, 2001 (United Nations Treaty Collections, 2024).
4. **Montreal Protocol on Substances that Deplete the Ozone Layer:** The Montreal Protocol is an international treaty aimed at phasing out the production and consumption of ozone-depleting substances (BYJU'S, 2023; Velders et al., 2007, United Nations Development Programme, 2007; United Nations Treaty Collection, 2016; Molina et al., 2009). Rwanda ratified the Montreal Protocol on 25 May 2017(United Nations Treaty Collections, 2024).

5. **Minamata Convention on Mercury:** The Minamata Convention is a global treaty designed to protect human health and the environment from the adverse effects of mercury pollution. Rwanda accessed to the Minamata Convention on 29/06/2017 (United Nations Treaty Collections, 2024).
6. **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal:** Rwanda ratified the Basel Convention on January 7,2004 and the entry into force was on April 6, 2004 (United Nations Treaty Collections, 2024). The convention aims to minimize the generation of hazardous wastes and promote environmentally sound management of such wastes (BYJU'S, 2023; Secretariat of the Basel Convention, 2003).
7. **Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade:** Rwanda ratified the Rotterdam Convention on January 7,2004 and the entry into force was on April 6, 2004 (United Nations Treaty Collections, 2024). The convention regulates trade in hazardous chemicals and pesticides to ensure informed decision-making by importing countries (BYJU'S, 2023).
8. **Stockholm Convention on Persistent Organic Pollutants (POPs):** Rwanda accessed to the Stockholm Convention on 5 June 2002 (United Nations Treaty Collections, 2024). The convention aims to eliminate or restrict the production and use of persistent organic pollutants that pose significant risks to human health and the environment (BYJU'S, 2023).
9. **United Nations Framework Convention on Climate Change (UNFCCC):** Rwanda became a party to the UNFCCC on 10 Jun 1992 and ratified the convention on 18 August 1998 (United Nations Treaty Collections, 2024). The convention sets out a framework for international cooperation to combat climate change through mitigation and adaptation measures ((BYJU'S, 2023; Bodansky,1993; UNFCCC, 1992).
10. **Bamako Convention on the ban of the import to Africa and control of transboundary movement and management of hazardous wastes within Africa:** Rwanda is party of this convention adopted in Bamako, Mali, on 30 January, 1991 (REMA, 2021).

3.3. Laws, policies and programs contributing on air pollution prevention in Rwanda

3.3.1.Laws contributing on air pollution prevention in Rwanda

The laws, regulations and policies related to the environmental protection, management and mitigation in Rwanda include the following:

1. **Law N°48/2018 of 13/08/2018 on environment:** This law addresses air pollution as a critical environmental issue within the country. The law aims to regulate and control activities that contribute to air pollution, ensuring the protection of public health and the environment. It outlines

measures for monitoring air quality, setting emission standards, and implementing strategies to reduce air pollution levels. Additionally, the law emphasizes the importance of public awareness and participation in combating air pollution through education and advocacy programs. The legislation also establishes penalties for non-compliance with air quality standards and regulations, aiming to enforce accountability among individuals, industries, and organizations that contribute to air pollution (Republic of Rwanda, 2018). By implementing this law, Rwanda demonstrates its commitment to sustainable development and environmental conservation by addressing the detrimental effects of air pollution on human health and ecosystems. Overall, Law N°48/2018 on environment in Rwanda plays a crucial role in promoting environmental sustainability and protecting public health by addressing air pollution through comprehensive regulatory measures.

2. **Law N° 18/2016 of 18/05/2016 governing the preservation of air quality and prevention of air pollution in Rwanda:** This Law applies to all measures aimed at the preservation of air quality as well as all elements or activities likely to affect air quality or pollute the atmosphere. It aims to protect public health and the environment by regulating activities that contribute to air pollution. The law establishes standards for emissions from industrial facilities, vehicles, and other sources of pollution. It also outlines monitoring and enforcement mechanisms to ensure compliance with these standards. Additionally, the law includes provisions for public awareness and education on air quality issues, as well as measures to promote sustainable development practices that reduce air pollution (Republic of Rwanda, 2016).
3. **Ministerial Order 2 of 2018 relating to Air Pollutants Emission:** this is a regulatory document issued by a government minister that pertains to the control and regulation of air pollutants emissions. This order outlines specific guidelines, rules, and restrictions aimed at reducing the emission of harmful substances into the atmosphere to protect public health and the environment. It typically includes provisions related to permissible emission levels, monitoring requirements, reporting obligations, enforcement mechanisms, and penalties for non-compliance.
4. **Law N° 049/2023 of 05/09/2023 establishing Value Added Tax:** VAT is a consumption tax that is added to the price of goods and services at each stage of production and distribution. It is ultimately borne by the final consumer, making it a significant source of revenue for the government (Bovenberg and Goulder,2002). The implementation of VAT in Rwanda is aimed at broadening the tax base, increasing government revenue, and promoting economic growth. VAT is collected by businesses on behalf of the government and is ultimately passed on to consumers in the form of higher prices. The exemption for goods related to air pollution prevention under Law N° 049/2023 aims to incentivize businesses and individuals to invest in environmentally friendly

products and technologies (Republic of Rwanda, 2023). The following goods and services are exempted from value added tax:

- energy supply equipment that appear on the list established by the Minister in charge of energy and approved by the Minister;
- imported electric automotive vehicles, hybrid automotive vehicles, relevant batteries and their electric charging station equipment.

By exempting these goods from VAT, the government encourages the adoption of sustainable practices that help mitigate air pollution and protect public health. This exemption aligns with Rwanda's commitment to environmental sustainability and climate action (Republic of Rwanda; MINECOFIN, 2017). By promoting the use of clean technologies and reducing emissions, the country contributes to global efforts to combat climate change and improve air quality for its citizens. The law represents a significant step towards integrating environmental considerations into Rwanda's tax system and promoting sustainable development through fiscal policy (Bosquet, 2000; Republic of Rwanda, 2023).

3.3.2. Policies contributing on air pollution prevention in Rwanda

Rwanda has made significant strides in developing environmental policies to address various issues, including air pollution prevention. The country has recognized the importance of protecting its environment and public health by implementing regulations and initiatives to reduce air pollution and promote sustainable development.

Air pollution prevention is a critical issue in Rwanda, due to the adverse effects it can have on public health and the environment. The Rwandan government has established various policies and initiatives to address this issue and reduce air pollution levels in the country. Some of those policies are the following:

1. **Rwanda environmental policy (2010):** The National Environment Policy (NEP) was established to provide a framework for sustainable environmental management (Ministry of Lands, Resettlement and Environment, 2003; Ministry of Natural Resources, 2010; Ministry of Environment, 2019). The NEP focuses on promoting sustainable development, conserving natural resources, and mitigating environmental degradation, including air pollution. In terms of air pollution prevention, Rwanda has taken several measures to reduce emissions and improve air quality. The country has implemented regulations on vehicle emissions, industrial pollution, and waste management to limit pollutants released into the atmosphere. Rwanda has also invested in renewable energy sources such as solar power to reduce reliance on fossil fuels, which contribute to air pollution (Gabriel Okello et al, 2022; Karekezi and Mwumvaneza, 2002).

Furthermore, Rwanda has launched initiatives to raise awareness about the importance of clean air and environmental conservation among its citizens. Public education campaigns and community engagement programs have been instrumental in promoting sustainable practices and reducing pollution levels in the country.

Overall, Rwanda's environmental policy and efforts to prevent air pollution reflect its commitment to sustainable development and environmental conservation. By implementing regulations, investing in renewable energy, and raising public awareness, Rwanda is taking proactive steps to protect its environment and public health for future generations.

2. **National environment and climate change policy (2019):** Rwanda's national environment and climate change policy framework is guided by the National Climate Change and Environment Policy (NCCEP), which was developed to address the country's vulnerability to climate change and promote sustainable development (Ministry of Environment, 2019). The NCCEP outlines strategies for reducing greenhouse gas emissions, enhancing resilience to climate change impacts, promoting sustainable land management practices, and conserving biodiversity.

One of the key initiatives under Rwanda's national environment and climate change policy is the Green Growth and Climate Resilience Strategy (GGCRS). The GGCRS aims to promote sustainable economic growth while reducing greenhouse gas emissions and enhancing resilience to climate change impacts. The strategy focuses on key sectors such as agriculture, energy, water resources, and urban development to achieve green growth objective (Republic of Rwanda, 2022).

3. **National urbanization policy (2015):** Air pollution prevention is a critical dimension in the National Urbanization Policy in Rwanda. As the country experiences rapid urbanization, there is a growing concern about the negative impacts of air pollution on public health, the environment, and overall quality of life. The Rwandan government has recognized the importance of addressing air pollution in urban areas and has integrated measures to prevent and control it within its national urbanization policy framework (ministry of Infrastructure, 2015).

One of the key strategies employed in Rwanda's National Urbanization Policy to prevent air pollution is the promotion of sustainable transportation systems. By investing in public transportation infrastructure, such as buses and cycling lanes, the government aims to reduce reliance on private vehicles, which are a significant source of air pollutants. Additionally, promoting non-motorized transport modes like walking and cycling not only helps reduce emissions but also contributes to a healthier population (UNEP, 2017).

Another important aspect of air pollution prevention in Rwanda's urbanization policy is the enforcement of regulations and standards for industries and vehicles. By setting emission limits for factories and ensuring that vehicles meet certain environmental standards, the government can effectively reduce air pollution levels in urban areas. Regular monitoring and enforcement mechanisms are essential to ensure compliance with these regulations (REMA, 2018).

Furthermore, the National Urbanization Policy in Rwanda emphasizes the importance of green spaces and urban planning in mitigating air pollution. By incorporating parks, gardens, and green infrastructure into urban design, the government can help absorb pollutants, provide oxygen, and create a healthier living environment for residents. Green spaces also contribute to reducing the urban heat island effect, which can exacerbate air pollution issues.

In addition to these strategies, public awareness campaigns and education programs play a crucial role in preventing air pollution in urban areas. By informing the public about the health risks associated with poor air quality and promoting sustainable practices such as waste management and energy efficiency, the government can foster a culture of environmental stewardship among its citizens.

Overall, integrating air pollution prevention measures into the National Urbanization Policy is essential for ensuring sustainable development in Rwanda's rapidly growing urban centers. By adopting a holistic approach that combines infrastructure development, regulatory enforcement, green planning, and public engagement, the government effectively addresses the challenges posed by air pollution and create healthier and more livable cities (Ministry of Infrastructure, 2015).

3.4. Programs contributing on air pollution prevention in Rwanda

Several programs are being implemented to address and prevent air pollution, which is a significant environmental and public health concern in Rwanda. These programs focus on various aspects of air quality management, including monitoring, regulation, public awareness, and sustainable development practices. Some of the key initiatives contributing to air pollution prevention in Rwanda include:

1. **Vehicles inspection and maintenance programs:** Rwanda, like many other developing nations, faces challenges related to vehicle emissions and air pollution due to the increasing number of vehicles on the roads. The government of Rwanda has taken steps to address this issue by introducing regulations and policies aimed at controlling vehicle emissions and promoting sustainable transportation practices (PA Government Services, 2004; United Nations Environment Programme, 2018). One of the key strategies for controlling vehicle emissions in Rwanda is the implementation of vehicle inspection and maintenance programs. These programs require regular

testing of vehicles to ensure they meet emission standards set by the government. Vehicles that fail to meet these standards are required to undergo repairs or upgrades to reduce their emissions. By enforcing these programs, Rwanda aims to reduce the amount of pollutants released into the atmosphere by vehicles, thereby improving air quality and public health (Okello et al., 2022); Cohen et al., 2017). Technical control of vehicles and air pollution prevention in Rwanda requires a multi-faceted approach that combines regulatory measures, technological advancements, public awareness campaigns, and infrastructure development. By implementing these strategies effectively, Rwanda work towards reducing vehicle emissions, improving air quality, and creating a healthier environment for its citizens.

- Promoting the use of cleaner fuels and technologies in the transportation sector:** In addition to vehicle inspection and maintenance programs, Rwanda is also promoting the use of cleaner fuels and technologies in the transportation sector. This includes encouraging the use of low-sulfur fuels, promoting the adoption of electric vehicles, and investing in public transportation infrastructure to reduce reliance on private vehicles. By transitioning to cleaner fuels and technologies, Rwanda reduces emissions from vehicles and mitigate air pollution in urban areas (United Nations Environment Programme, 2018; GGGI, 2015; RTDA, 2019).

Promoting the use of cleaner fuels and technologies in the transportation sector in Rwanda is crucial for mitigating environmental pollution, reducing greenhouse gas emissions, and improving public health. Rwanda, like many other developing countries, faces challenges related to air pollution and climate change due to the reliance on traditional fossil fuels in the transportation sector. By transitioning to cleaner fuels such as biofuels, compressed natural gas (CNG), and electric vehicles, Rwanda can significantly reduce its carbon footprint and improve air quality.

One of the key strategies for promoting cleaner fuels and technologies in the transportation sector in Rwanda is through policy interventions and incentives. The government implements regulations that encourage the adoption of cleaner fuels and technologies, such as tax incentives for electric vehicles or subsidies for biofuel production (Republic of Rwanda, 2023). Additionally, investing in infrastructure for alternative fueling stations and charging stations for electric vehicles facilitate the transition to cleaner transportation options. Furthermore, raising awareness among consumers about the benefits of using cleaner fuels and technologies is essential. Public education campaigns highlighting the environmental and health advantages of switching to cleaner transportation options drive consumer demand for these alternatives. Collaborations between government agencies, private sector stakeholders, and international organizations also play a significant role in promoting the adoption of cleaner fuels and technologies in Rwanda's transportation sector.

In conclusion, promoting the use of cleaner fuels and technologies in the transportation sector in Rwanda is a critical step towards achieving sustainable development goals, reducing carbon emissions, and improving air quality for all inhabitants.

3. **Investment in renewable energy to increase access to clean and affordable energy for citizens:** One of the key strategies employed by Rwanda to promote clean energy and reduce air pollution is the promotion of renewable energy sources such as solar, wind, and hydropower. The government has invested in renewable energy projects to increase access to clean and affordable energy for its citizens (Karekezi and Mwumvaneza, 2002; Republic of Rwanda, 2017; Republic of Rwanda, 2018; Republic of Rwanda; 2019; Republic of Rwanda, 2022; MININFRA, 2019). These initiatives not only help reduce reliance on fossil fuels but also contribute to mitigating air pollution by decreasing emissions from traditional energy sources. Rwanda's efforts to promote clean energy and prevent air pollution are crucial for sustainable development and environmental conservation (Republic of Rwanda, 2013; MINECOFIN, 2017). By investing in renewable energy sources, implementing stringent regulations, and engaging in international cooperation, Rwanda is taking significant steps towards a cleaner and healthier environment for its citizens.
4. **Accelerating household access and adoption of clean energy:** Accelerating household access and adoption of clean energy in Rwanda is a crucial step towards achieving sustainable development and addressing climate change. Rwanda, like many other developing countries, faces challenges in providing reliable and affordable energy to its population. The government of Rwanda has recognized the importance of clean energy in improving energy access, reducing greenhouse gas emissions, and promoting economic development. In recent years, various initiatives have been implemented to accelerate household access and adoption of clean energy in Rwanda (United Nations Environment Programme, 2018). One key initiative is the promotion of off-grid renewable energy solutions such as solar home systems and mini-grids. These technologies provide households with access to electricity in areas where grid extension is not feasible. The government has also implemented policies and programs to support the adoption of clean cooking solutions, such as improved cookstoves and biogas digesters, which can help reduce indoor air pollution and deforestation. Furthermore, financial incentives and innovative financing mechanisms have been introduced to make clean energy technologies more affordable for households. Public-private partnerships have played a significant role in scaling up clean energy access in Rwanda, with companies partnering with the government to provide energy solutions to underserved communities. Education and awareness-raising campaigns are also essential to promote the benefits of clean energy technologies and encourage their adoption among

households. By investing in capacity building and training programs, Rwanda aims to empower communities to take advantage of clean energy solutions and contribute to sustainable development. Overall, accelerating household access and adoption of clean energy in Rwanda requires a multi-faceted approach that involves policy support, financial incentives, public-private partnerships, and community engagement. By prioritizing clean energy access, Rwanda is improving living standards, reducing environmental impact, and achieving its sustainable development goals.

- 5. Car free day initiative:** Car Free Day is an initiative that aims to reduce traffic congestion, promote sustainable transportation, and raise awareness about environmental issues by encouraging people to use alternative modes of transportation such as walking, cycling, or public transport instead of driving private vehicles (Subramanian et al. 2020; United Nations Environment Programme, 2018). Car Free Day events are organized in cities around the world to promote a cleaner and healthier urban environment. The Car Free Day initiative in Rwanda was launched in 2016 by the City of Kigali in partnership with various stakeholders, including government agencies, non-governmental organizations, and the private sector. The main objective of Car Free Day in Rwanda is to promote physical activity, reduce air pollution, and create a sense of community among residents. During Car Free Day events, certain streets in Kigali are closed to motorized vehicles, allowing people to walk, run, cycle, or participate in various recreational activities. The Car Free Day initiative has been well-received in Rwanda, with thousands of people participating in the monthly events.

In addition to promoting sustainable transportation and environmental awareness, Car Free Day also provides an opportunity for local businesses to showcase their products and services to a large audience. The success of Car Free Day in Rwanda has inspired other cities in Africa to adopt similar initiatives as part of their efforts to create more livable and sustainable urban environments. Overall, Car Free Day in Rwanda serves as a platform for promoting healthy lifestyles, reducing carbon emissions, and fostering a sense of community among residents. By encouraging people to embrace alternative modes of transportation and reduce their reliance on private vehicles, Car Free Day contributes to the development of more sustainable and environmentally friendly cities (Kalisa et al., 2021; UNEP, 2017; GGGI, 2015; SSATP, 2018).

- 6. Car free zones:** A car-free zone, also known as a pedestrian zone or car-free district, is an area where motor vehicles are prohibited or restricted to create a safer and more sustainable environment for pedestrians and cyclists. In Rwanda, the concept of car-free zones has been implemented in certain areas to promote alternative modes of transportation, reduce traffic

congestion, improve air quality, and enhance the overall quality of life for residents (United Nations Environment Programme, 2018).

The city of Kigali, the capital of Rwanda, has been at the forefront of promoting car-free zones as part of its efforts to become a more sustainable and livable city. One notable example is the Car Free Zone in the central business district of Kigali, which was established to encourage walking, cycling, and public transportation while reducing reliance on private cars. The Car Free Zone is typically closed to motor vehicles on designated days, allowing pedestrians and cyclists to enjoy the space without the noise and pollution associated with traffic.

The implementation of car-free zones in Rwanda aligns with the country's broader goals of promoting sustainable urban development, reducing greenhouse gas emissions, and improving public health. By prioritizing non-motorized modes of transportation and creating pedestrian-friendly spaces, Rwanda aims to create a more inclusive and environmentally friendly urban environment for its residents (SSATP, 2018; Kalisa et al., 2021; Ministry of Infrastructure, 2015).

Overall, car-free zones in Rwanda represent a proactive approach to urban planning that prioritizes people over cars and seeks to create vibrant and sustainable communities for all.

4. CONCLUSION

In Rwanda, several programs and initiatives are being implemented to address air pollution and promote environmental sustainability. These programs aim to reduce emissions, improve air quality, and raise awareness about the importance of environmental protection.

In addition to promoting renewable energy, Rwanda has also implemented policies and regulations to improve air quality. The government has introduced emission standards for vehicles and industries to limit the amount of pollutants released into the atmosphere.

Furthermore, Rwanda has engaged in international partnerships and initiatives to address air pollution at a regional level. The country is a signatory to various international agreements aimed at reducing greenhouse gas emissions and improving air quality. By collaborating with other countries and organizations, Rwanda can leverage resources and expertise to implement effective strategies for air pollution prevention.

Furthermore, Rwanda has invested in public transportation systems and promoted cycling as a means of reducing emissions from private vehicles. Public awareness campaigns and education initiatives play a crucial role in addressing air pollution in Rwanda. By raising awareness about the impacts of vehicle emissions on air quality and public health, the government can encourage individuals to adopt sustainable transportation practices such as carpooling, cycling, or using public transportation. Educating the public about the importance of reducing vehicle emissions fosters a culture of environmental responsibility and promote behavior change towards more sustainable modes of transportation.

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