The Research Agenda of Kenya's Environmental Diplomacy Pillar: An Opportunity to Mitigate Air Pollution in Kenya

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Abstract. This study sought to examine the research agenda of Kenya's environmental diplomacy pillar by drawing insights on one of pillar's objectives, which is to promote research as a mechanism to encourage innovation and reduce the adverse effects of environmental threats. The study interrogates four issues. Firstly, the extent of research on environmental issues and its contribution to mitigating air pollution. Secondly, the importance of the attached research agenda at the policy level. Thirdly, this study assesses milestones in air pollution innovations and their relevance to air pollution policy formulation. Finally, the study examines the effectiveness of environmental audits. The study employed an exploratory research design and targeted 130 critical informants from institutions dealing with environmental issues and diplomacy in Kenya. This study found that, despite increased global attention to ecological security in recent years in academia and policy, there is generally limited research and technological innovation in air pollution to support the country's pursuit of a carbon-free economy. The findings were based on descriptive statistics and conceptual content analysis of primary and secondary data. The study also underscores a dearth in assessing potential research areas on air pollution. It, therefore, recommends that all relevant institutions prioritise research to transform the energy sector, develop evidence-based environmental policies and strategies, and encourage technology transfer to facilitate domestic innovations in air pollution mitigation.

Keywords: Air pollution; environmental diplomacy; environmental diplomacy pillar; research agenda.

INTRODUCTION

Environmental debates have lately become an area of interest in international politics, evidenced by the rise in international agreements on the environment urging collective efforts by states to address environmental pollution [1, 2]. The multilateral approach to ecological challenges can be traced back to the United Nations Conference on the Human Environment (UNCHE) in 1972 in Stockholm and has not relented to date as marked by the first ever Africa Climate Summit (ACS) held in Nairobi, Kenya in September 2023. These summits provide evidence for further inter-state collaborative actions to environmental security threats [3].

Ever-increasing pressure from production activities, driven by the expanding world population, is causing increased air pollution [4]. Consequently, the current era's atmosphere can be described as polluted [3]. Climate change due to air pollution is the most devastating. Worryingly, most big cities, particularly in developing countries, experience severe air pollution, a situation expected to worsen soon as their population increases [5].

Due to massive urbanisation in the developed world, European urban populations are exposed

to unsafe air pollutants [6]. Similarly, in China, many people suffer grave air pollution effects, some of which result in fatalities [7]. In Europe and China, urbanisation and industrialisation have emerged as critical pollutants. The air pollution situation in Africa is complicated by poverty, a sharp population rise, and rapid urbanisation [8].

Many global states have adopted various international treaties and domestic legal and policy frameworks to address environmental pollution and its consequences. Kenya, in 2014, made a significant stride by including an environmental diplomacy pillar in its foreign policy document, thereby solidifying its commitment to international environmental efforts. Among others, the pillar aimed at promoting research to encourage innovation and reduce adverse environmental impacts [9]. These efforts notwithstanding, air pollution in the country continues with pollution levels, particularly in the capital city, Nairobi City County, going beyond the safe limits set by the World Health Organization (WHO) [10]. Therefore, this study aimed to address this inconsistency by examining the extent of research on environmental issues and their contribution to mitigating air pollution in Kenya.

Literature Review

Theoretical Review. The study was anchored on sustainable development theory as postulated by Safwat Shakir Hanna and Gian Paolo Cesaretti in 2019. The theory is a derivative of two concepts, sustainable and sustainability, coined in the 20th century [11]. These concepts underscore the need to shield the environment from human interference through sustainable exploitation of resources. The UNCHE in 1972 ushered the theory into the moulding phase with increasing recognition that development activities prioritised economic growth to the detriment of the environment [11]. Therefore, Sustainable development theory is a call to consider the polluting effects of development activities on the environment [12]. In such consideration, research on environmental issues has enormous potential to stimulate the development of environmentally friendly technology and reduce negative environmental impacts.

Empirical Review. Research plays several significant roles in society [13]. The United Nations Framework Convention on Climate Change (UNFCCC) advocates for continuous scientific research to sustain economic development. The United States of America (USA) is regarded as a leading advocate for science and research on environmental matters [14]. Borrowing a leaf from the USA, Kenya's environmental diplomacy pillar likewise positions research as a critical enabler in achieving environmental health objectives in a globalised context [9]. Therefore, this study was important for establishing the extent to which ecological research has been conducted in Kenya and the importance placed on research on air pollution issues.

Among other roles, research drives innovation and technological advancement [13]. Technology is crucial to environmental well-being by providing environmentally friendly energy sources like wind, solar, and geothermal, producing more efficient engines, lowering emissions and enabling better ecological health monitoring. Insufficient technological capacity was observed as a significant obstacle in the environmental sector of many African states [15]. Therefore, this was an area of interest for this study to understand what innovations had been achieved towards addressing air pollution challenges.

Further, research significantly affects the states' mechanisms for controlling environmental pollution. It is also vital for accelerating the pace and scale at which environmentally friendly technology displaces inferior technology [16]. The Paris Agreement on Climate Change (2015) promotes technological development and technology transfer to reduce air pollution and enhance resilience to climate change. The new technology so transferred should better protect the environment, pollute less, utilise resources sustainably, and dispose of any residuals in an environmentally acceptable manner. This study examines the strides made by Kenya in terms of the transfer of environmentally friendly technology.

Existing literature indicates that China has undertaken promising research and development steps to replace inefficient power and industrial technology and invest in renewable energy, including nuclear energy. These steps can reduce China's air pollution and carbon footprint [17]. Meanwhile, Denmark has instituted bold policies on environmentally friendly technology backed by world-class research and a goal to be independent of fossil fuels by 2050 [17]. The country has earmarked 2030 as a target year to produce all electricity consumed in Denmark from re-

newable sources, thus phasing out all petrol and diesel engine vehicles. As part of this study's objective, it will be vital to assess the contribution of Kenya's environmental research to the innovative use of renewable sources of energy.

Research and innovation have ensured that new technologies are found to enhance environmental health. For instance, remote working technologies supported by Information and Communication Technology (ICT) came into being and became popular due to travel restrictions at the height of the COVID-19 pandemic [18]. Like remote working technologies, e-shopping advances, among others, have reduced road traffic, offering an opportunity for potentially decreasing emissions. Additionally, technologies aimed at reducing energy consumption may be the most effective solution to air pollution. Household energy efficiency technologies, ranging from design innovations to appliances, present an area of focus for innovative intervention [19].

Apart from innovation, states can conduct environmental research to gain new knowledge about pollution. For example, studies conducted in the 20th century led to associating environmental degradation with development [20]; this formed the basis for discussions during the 1992 UNCED in Rio de Janeiro. The critical question is how long the world could sustain economic growth without risking annihilating the environment beyond repair [21]. The answer presents a rich area for state-specific research to scientifically define necessary trade-offs between the desire for economic development and attaining high environmental standards.

The contradicting arguments in extant literature are of interest in such a discourse. Firstly, environmental pollution and economic growth have a positive relationship; secondly, the relationship is inverse; and a third category is that the relationship varies along a state's development path, sometimes positive and other times negative [21]. Each of these outcomes has significant implications for a country's policy. A positive relationship may signal the need for strict environmental policy coupled with restrictions on economic growth to protect the environment.

The adopted policy functions to lower the environmental price of economic growth for sustainable outcomes. This area has attracted debate since it is politically unacceptable to question economic growth. Therefore, no state or institution will volunteer to limit its development for the environment's sake. Other scholars have cited the significant reduction in emissions during the economic slowdown occasioned by COVID-19 as a typical example of the direction states should take [7]. This study explored the place of environmental research in informing development decisions in Kenya.

Related to the preceding, research on environmental issues could allow modelled predictions based on currently available data and prevailing trends. Such predictions would facilitate preparedness for environmental pollution-related crises like the increase in ailments and prevalence of droughts and famine while allowing early and timely interventions to prevent such hazards. For example, the Organization for Economic Cooperation and Development (OECD) conducts research and gives an environmental outlook for the future [22]. Kenya is not a member of the OECD. While such predictions may provide the general status due to the borderless nature of the environment, the country could gain more by investing in environmental research to generate predictions based on the local context.

The environmental diplomacy pillar research objective further seeks to engage research specifically as a tool for reducing adverse environmental impacts. Such research would aim to identify better ways of doing things, increase project benefits, avoid or remedy adverse impacts and keep residual adverse impacts at acceptable levels. Environmental Impact Assessment (EIA) is an ideal model to guide research in this area. As a research process, EIA proceeds systematically to examine, in advance, the environmental consequences of development actions [23]. An examination of how Kenya has employed such tools is essential.

Kenya Environmental Management and Coordination Act (EMCA) provides for EIA, obliging project proponents to conduct or cause to be conducted and meet the cost of EIA studies [24]. Authorities must conclude and appropriately sanction an EIA before implementing a project. Despite the application of EIA as a robust tool in environmental management for the past several years, widespread air pollution persists in Kenya [25]. This situation begs further scholarly scrutiny and, therefore, was the subject of this study.

METHOD

The study used an exploratory research design appropriate for research in areas where few previous studies have been conducted [13]. Unlike other types of diplomacy, environmental diplomacy in Kenya has not received sufficient scholarly attention. Specifically, critical aspects like research on ecological issues have yet to be adequately studied.

The study area was Nairobi City County, the Kenyan capital, which is the headquarters of key ministries, departments, agencies, and other institutions concerned with the environment and diplomacy. Further, according to the UNEP data, Nairobi suffers the most severe air pollution.

The target population for the study was composed of critical informants, including diplomats, environmentalists, energy specialists, transport specialists, environmental law specialists and parliamentarians. Purposive sampling was adopted to identify participants with knowledge in the areas of interest while snowballing sampling was used to seek out additional respondents. The researchers drew a sample of 30% from each population category [26]. Table 1 below gives a summary of the target population and the sample size drawn.

Table 1 – Target Population and Sample Size by Categories

Category	Target Population	Sample Ratio	Sample Size
Diplomats	20	0.3	6
Environment	20	0.3	6
Energy	15	0.3	4
Transport	15	0.3	4
Environmental law	10	0.3	3
Parliament/ Senate	5	0.3	2
Other key informants	45	0.3	14
Total	130		39

The researchers collected both primary and secondary data. They used semi-structured questionnaires to gather the primary data. The open-ended questions in the questionnaires allowed the participants to provide varied responses, which is crucial for an exploratory study. The researchers used a document review guide to collect secondary data from reports, records, journals, policy documents, treaties, and books.

The researchers used descriptive statistics to analyse data on the participants' background information and applied conceptual content analysis to examine data from the substantive sections of the questionnaires. Conceptual content analysis encompassed classifying the data into critical themes aligned with the study objective, allowing the researcher to establish meanings and make interpretations systematically. The researchers presented the study findings in a narrative supported by tables.

RESULTS AND DISCUSSIONS

The study's sample size was 39 respondents. Twenty-eight respondents participated, representing 72%, but four questionnaires were rejected for being inconsistent and incomplete. The final response rate was, therefore, 62% and was considered adequate for data analysis and reporting [27].

Table 2 below summarises the background information of the respondents.

Table 2 – Background Information of the Respondents

Parameters	Parameters	Frequency	%
Sex	Male	13	54
	Female	11	46
	Total	24	
Age bracket	20-29 years	1	4
	30-39 years	12	50
	40-49 years	7	29
	50-59 years	4	17
	Total	24	
Years in the organisations	Below 5 years	9	38
	6-10 years	9	38
	11-15 years	2	8
	Above 15 years	4	16
	Total	24	

From Table 2, male respondents comprised 54%, while females comprised 46%, indicating a slightly higher number of male participants. However, the study found no significant variance in the perception of either sex regarding the study objective. On age, 4% of the participants were between 20-29 years, 50% between 30-39 years, 29% between 40-49 years and 17% were between 50-59 years. Thus, most of the respondents were in the middle age bracket. However, variance in responses across the various age categories was insignificant, and the study conclud-

ed that the age of the participants did not affect the results.

Regarding years in the organisations, 38% of the respondents had less than 5 years of experience, 38% had 6-10 years, 8% had 11-15 years, and 16% had above 15 years of experience. Thus, over 60% of the participants had at least 5 years of experience in the organisations and could sufficiently articulate issues on research on environmental and air pollution matters in Kenya. However, variation in the degree of informativeness across the different experience categories was not significant.

Extent of Research on Environmental Issues and its Contribution to Addressing Air Pollution in Kenya

Five thematic areas were used to methodically examine the extent of research on environmental issues and their contribution to mitigating air pollution in Kenya.

Extent of and Importance Attached to Research on Air Pollution. One of the objectives of Kenya's environmental diplomacy pillar is to promote research as a mechanism for encouraging innovation and reducing adverse environmental impacts. The study aimed to understand the extent of research conducted on air pollution issues and to determine the importance of research on air pollution matters in Kenya. Fifty per cent of the respondents indicated that researchers had conducted air pollution studies to a small extent or not at all. At the same time, 12% of the respondents felt that researchers had conducted the research to a moderate extent. In comparison, 16% stated that researchers had conducted air pollution studies to a large extent.

Approximately 22% of the respondents stated that they did not know whether researchers had conducted any studies on air pollution issues. Results on the importance given to research on air pollution issues mirrored those of the extent of research conducted, with 54% of the respondents indicating that little importance was attached to environmental research in Kenya. The reasons for this phenomenon included lack of aggressiveness in dealing with air pollution, inadequate funding, generally low interest in applied environmental studies, lack of a body to guide research on air pollution and low priority given to ecological research.

However, about 25% of the respondents observed that concerns over public health and international pressure due to global climate change offered opportunities for more research on air pollution. These responses point to new linkages that could bring the effects of air pollution closer home and catalyse research in the field. The finding of little research contradicts the call for the application of science and research on environmental matters [14].

Specific Innovations Related to Air Pollution and Friendly Technology Transfer. This study sought to understand what innovations had been achieved to address air pollution concerns as an objective of the environmental diplomacy pillar. It established that some environmentally friendly innovations were available in Kenya, including using electricity as a substitute for firewood, renewable energy sources and electric vehicles. These responses highlight some beneficial innovations to reduce air pollution.

However, 63% of the respondents felt that Kenya only imported environmentally friendly innovations without gaining the technology behind their designs to support domestic manufacturing and production. The cost of acquiring the innovations, therefore, remained high, thus prohibiting wide diffusion, with most economic activities still reliant on fossil fuels in the country. The respondents also indicated little local technological progress, hence few indigenous innovations. These findings contradict the call for accelerated research and innovation to displace inferior technology [16]. The phenomenon reflects observations that low technological capacity is a significant environmental challenge for many African countries [15].

Secondary data sought by the study did not find any express linkage between the environmental diplomacy pillar and research on air pollution matters in Kenya. However, the study established that researchers were conducting studies on air pollution under other related frameworks, including climate change. For example, Kenya's Second National Communication to the UNFCCC highlighted that different institutions undertook climate change-related research programs with the overall mandate bestowed on the Kenya Meteorological Department (KMD). KMD is tasked to collaborate with Africa's Inter-Governmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC) and the

Institute for Meteorological Training and Research (IMTR) in this aspect [28].

The National Climate Change Action Plan (NCCAP) 2018–2022 Second Implementation Status Report for the financial year 2019/2020, on the other hand, noted that the energy and transport sector in Kenya was focused on research in new and emerging technologies that could reduce greenhouse gas (GHG) emissions in the industry. The report included information on establishing a renewable energies research laboratory and energy efficiency research and testing facility at the Kenya Industrial Research and Development Institute (KIRDI). KIRDI is meant to take the lead in the search for sustainable energy solutions through dedicated research and undertake environmental sustainability research and consultancy for different agencies [29]. These findings conform with the observation made in China, where the Eastern Power had undertaken similar actions to reform its energy sector gradually [30].

The study also established that the lack of coordination mechanisms diminished the practical value of the research conducted. For instance, it observed that 33 academic studies on air pollution concentrations had been carried out in Kenya, mainly focusing on Nairobi, but the findings were hardly implemented. This was attributed to the fragmented nature of the studies, which created disjointed knowledge about air pollution and related challenges among researchers and policymakers, resulting in a lack of actionable insights [31].

Policy-wise, secondary data indicated that Kenya was keen on addressing air pollution through scientific approaches and international best practices. The data, for example, argued that research was identified as a fundamental aspect of Kenya's goal of transitioning to a low-carbon economy as encapsulated in Vision 2030. However, based on the respondents' views, such initiatives face uncertain implementation. It would thus be crucial that Kenya follows the steps taken by Denmark by robustly supporting their environmental policies through credible research and development to ensure fitness for purpose in the local context [17].

Secondary data also indicated that Kenya lacked specific policies to align environmental diplomacy with the transfer and diffusion of environmentally friendly technologies. References contained in other sectoral policies and legislations, including Vision 2030 and various Finance Acts, however, encourage international cooperation to facilitate the transfer of environmentally friendly technologies, call for support to developing countries to undertake technology needs assessment and associated capacity building and further encourage enhanced multilateral collaboration on intellectual property rights issues. Kenya should, for example, exploit diplomatic channels, including the posting of science and technology attaches to its foreign missions to facilitate the acquisition of environmentally friendly technologies from the host states.

Impact of Research on Air Pollution Policies and Disaster Preparedness. The study sought to establish whether environmental research had impacted Kenya's implementation of environmental policies. About 83% of the respondents indicated that there was either very little research on air pollution or research conducted on air pollution matters had not influenced policy development in any significant way. 4% of the respondents highlighted that success had been achieved in this area through, among others, setting up research committees to draft policies based on international environmental obligations and refine policy frameworks through reporting on outcomes of related meetings and drawing attention to the recommendations during international environmental engagements. These findings contrast observations on the solid steps taken by Denmark to build robust environmental policies based on credible research and development [17].

Regarding whether research contributed to mapping air pollution problem areas, 54% of the respondents felt that success in that aspect was low. 46%, on the other hand, indicated that monitoring of air pollutants, such as particulate matter, had been conducted in a few areas of Kenya, the results of which had informed the implementation of measures to improve air quality or curb further pollution. Such research involved using air quality sensors to capture health impact and mitigation assessment data. The outcome of this research indicated that Nairobi City County was still heavily polluted, far exceeding the permissible level of pollutants.

Researchers rated the availability of air quality outlooks as inexistent or insignificant. However, the study established that KMD provides real-time air quality data and weather reports for selected areas of Nairobi City County, though it

does not include predictive aspects. This finding contradicts the observation that the OECD conducts research and provides an environmental outlook for the future to support mitigation efforts [22].

Finally, 86% of the respondents felt that Kenya was unprepared for air pollution-related disasters, including climate change and diseases. While the study established that authorities were conducting air quality monitoring in some parts of Nairobi City County, they took little action due to a lack of funding and the embezzlement of funds for environmental disaster preparedness. The study identified broadcasting air quality warnings as an achievement toward readiness. Still, it noted that the effectiveness of such approaches could be affected by how they are packaged and the mode of dissemination adopted. The study recommended Nigeria's multichannel approach as the most effective [32].

Adoption of Environmental Audit and Research Tools. If authorities use them effectively, environmental audits and research tools like EIA are crucial to understanding air pollution issues. However, the study established that 38% of the respondents were unaware of how well environmental audit and research tools were adopted to address air pollution issues. In comparison, 38% of the respondents felt that authorities had adopted the tools to a small extent. Eight per cent thought the adoption rate was moderate, while 16% indicated that authorities had adopted them to a large extent. While 13% of the respondents noted that such tools were essential in ensuring sustainable practices and compliance with international standards, 67% indicated that environmental impact audits needed to be taken more seriously in Kenya. These findings agree with concerns over continued air pollution in Kenya despite the widespread conduct of EIAs [25].

Areas of Potential Research on Air Pollution. In conclusion, the researchers sought insights from the respondents on the areas that research on air pollution should focus on as a significant objective of Kenya's environmental diplomacy pillar. Table 3 below thematically summarises the responses obtained.

From Table 3, respondents identified energy, strategies and innovations as fundamental areas in research on air pollution. Thus, the respondents were aware of the weaknesses that hampered the effective attainment of Kenya's environmental diplomacy pillar research agenda. Based on these findings, the Kenyan government should seek to align its actions towards addressing the identified critical areas of ecological research.

Table 3 – Areas of Potential Research on Air Pollution

Theme	Comments
Energy	Clean energy solutions Renewable energy
Strategies	Emission reduction strategies Increasing citizen participation Localised air quality studies Enabling policy development
Innovations	Acquisition of environmentally friendly innovations Advancement in industrial filtration systems Clean technology transfer for local production
Others	Capacity building The link between air quality and diseases The link between poverty and bad environmental choices

CONCLUSIONS

Over time, research has provided answers to societal problems and environmental pollution, notably air pollution, which presents an area that can benefit immensely from scientific approaches. Innovations can potentially slow down air pollution and reduce its devastating effects on the environment and human life. Despite this potential, this study concluded that there was very little research on environmental issues in Kenya, although the country had policies calling for the scientific resolution of environmental challenges. The study also concluded that there was a gap in technology that allowed Kenya to move towards a carbon-free economy more rapidly. However, the fact that critical persons dealing with the environment and environmental diplomacy were aware of the areas that research should focus on presents a great starting point. These conclusions are essential as a basis for the government to frame future actions relating to environmental research.

The study thus recommended that the Government of Kenya and other relevant institutions prioritise research to transform the energy sector, develop environmental policies and strate-

gies informed by empirical evidence, and encourage technology transfer to facilitate domestic innovations; this would lower the cost and increase access to environmentally friendly alternatives.

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