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**IMPLICATIONS OF TRANSPORT POLICIES ON CARBON DIOXIDE (CO<sub>2</sub>)  
EMISSION FROM MOTORIZED ROAD TRANSPORT**

**\*<sup>1</sup>Martin Juma Achola, MA**

**<sup>1</sup>Professor Patrick Odhiambo Hayombe, PhD**

**<sup>2</sup>Professor Teresa Akenga, PhD**

**<sup>1</sup>Dr. Fredrick Omondi Owino, PhD**

<sup>1</sup>School of Spatial Planning and Natural Resource Management

Jaramogi Oginga Odinga University of Science and Technology, Bondo, Kenya

<sup>2</sup>University of Eldoret, Eldoret, Kenya

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**ABSTRACT:** *Global warming experienced on the earth in the last few decades has been attributed to greenhouse effect caused by accelerated CO<sub>2</sub> emissions from the burning of fossil fuels. This study determined and described the effectiveness of transport policies on emission of CO<sub>2</sub> from motorized road transport system in Kisumu City using stakeholder and document analyses. The theoretical framework of this study was the Systems Theory and the Clean Development Mechanism. The study recommended that the government should invest heavily in the public transport sector by enacting laws and policies aimed at discouraging the importation and use of low seating capacity vehicles and invest in the high seating capacity vehicles (BRT) and non-motorized road transport.*

**KEY WORDS:** transport policies, carbon dioxide (CO<sub>2</sub>), emission motorized road

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## **INTRODUCTION**

The earth has experienced global warming since 1980 (US NRC, 2012). Most scientists agree that most global warming is caused by increasing concentrations of greenhouse gases produced by human activities such as deforestation and burning of fossil fuels (IPCC, 2013). These findings are recognized by the national science academies of all the major industrialized countries and are not disputed by any scientific body of national or international standing (US NRC, 2010; Cook, 2016). Fossil fuel burning has produced about three-quarters of the increase in CO<sub>2</sub> from human activity over 20 years (IPCC, 2007). CO<sub>2</sub> emissions are continuing to rise due to the burning of fossil fuels and land-use change (World Bank, 2010a; US NRC, 2008). CO<sub>2</sub> readings taken in May 2013 at the World's primary benchmark site in Mauna Loa surpassed 400 parts per million (ppm), the highest in about 4.5 million years (Clark, 2013). It is expected that most ecosystems will be affected by higher atmospheric CO<sub>2</sub> levels, combined with higher global temperatures and most economic studies suggest losses of World Gross Domestic Product (GDP) for this magnitude of warming (IPCC, 2007). Evidence of global warming includes observed increases in global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (US GCRP, 2010).

The automobile is a primary mode of transportation for many developed economies with one-third of world automobile demand in the BRICS markets (Brazil, Russia, India, China and South Africa) (Eisenstein, 2011). NEPAD approximated that the number of both public and private vehicles on the road in Africa in 2006 to be 20 million. Out of this number 11% were in East Africa most of which were in poor condition (UN, 2009). According to The Kenya

National Bureau of Statistics (KNBS), Kenya had a total of about 1 million registered vehicles by the year 2008 with an annual registration of about 121,000 during the same year. The status as at 2017 is about 300,000 new registrations (KNBS, 2019). This is an alarming increase since the new registration has more than doubled in about 10 years. Kisumu City with a population of 404,160 in 2009 is projected to have a population of 538,089 in 2019.

It is expected that the number of vehicles operating within Kisumu City will significantly increase to meet the transport needs of the growing population. This shows a potential demand for investment in transport infrastructure. Proper utilization of such huge investments necessitates systematic planning for need-based development which includes determination of the required capacity expansion, provision of additional road infrastructure, improvement of existing roads, emission control, transport pooling, prioritization of different development phases and forecasting for feasibility.

### **Research Problem**

Many governments across the world have put measures aimed at reducing the emissions from motorized road transport in an attempt to domesticate the Kyoto Protocol. Despite all these efforts, there has been continued increase in emissions from various road transport sectors. The legal framework in the road transport sector is poorly regulated and has limited capacity to control emissions and this has been responsible for the increased emissions of CO<sub>2</sub> seen in the motorized road transport. There was need to evaluate the extent of adherence by stakeholders to the legal framework.

### **Study Objectives**

- i. To analyze the road transport policies and their implications on CO<sub>2</sub> mitigation.
- ii. To suggest a strategy for planning of low carbon emitting urban PSV transport.

### **METHODOLOGY**

This study used survey research design. Survey research provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. From sample results, the researcher generalizes or makes claims about the population. It includes studies using questionnaires or structured interviews for data collection, with the intent of generalizing from a sample to a population (Creswell, 2009; Mugenda & Mugenda, 2013). The design is economical, convenient and rapid in data collection.

Stakeholder and content analysis and percentages were used to analyze the transport policies and their implications on CO<sub>2</sub> mitigation. Each policy was analyzed and CO<sub>2</sub> mitigation strategy highlighted. Stakeholder Analysis was used to identify the stakeholders and their needs with an aim of developing a strategic view of the human and institutional landscape of the study based on their power and influence (Mitchell, Agle & Wood, 1997; OGC, 2006). Content Analysis was used to study documents, International Agreements, policies and legislations by systematic reading and identifying texts which were coded to indicate the presence of desired meaning (Kimberly, 2016).

## RESULTS AND DISCUSSIONS

### Analysis of Road Transport Policies and Their Implications on CO<sub>2</sub> Mitigation

The main aim of this objective was twofold:

- i. To identify major transportation stakeholders and their interest and impact on CO<sub>2</sub> mitigation.
- ii. To identify official environmental and transport legislations, policies and interventions and their responsiveness to CO<sub>2</sub> mitigation

The following stakeholders in the first column were identified and divided into primary and secondary. The second column specifies the interest of each stakeholder, some which are obvious and others may be hidden. The third column indicates the likely impact of the project on the stakeholder. Here, + is potential positive impact on interest, - is potential negative impact on interest, +/- is possible positive and negative impact on interest and ? is uncertain. In the fourth column is the priority that the project should give to each stakeholder in meeting their interests in a scale of 1 to 5 where 1 is the highest priority.

**Table 1: Stakeholder Analysis**

Stakeholders	Interest	Likely Impact of Regulated Motorized Transport	Priority
<b>Primary</b>			
1. Drivers	Income	+/-	1
2. Conductors	Income	+/-	1
3. Owners	Income	+/-	1
4. Passengers	Movement	+	1
5. Saccos	Safety and Income	+	2
6. Stage Management	Safety and Income	+	2
7. Motorcycle and Tricycle Riders	Income	+/-	1
8. Bicycle Riders	Income	-	2
9. Automobile Sellers	Income	-	2
<b>Secondary</b>			
1. Environment Office	Better Health	+	3
2. Public Health office	Better Health	+	3
3. Traffic police	Safety and Order	+	4
4. Ministry of Transport	Safety and order	+	4
5. Land Planning Office	Order	+	4
6. Vendors	Income	+	5

The stakeholders in Table 1 were grouped by the author into their level of importance to and influence on the regulation of motorized road transport.

**Table 2: Importance and Influence of Stakeholders**

	<b>Low Influence</b>	<b>High Influence</b>
<b>Low importance</b>	Vendors Bicycle riders Automobile Companies	Land Planning Office Ministry of Transport Traffic Police
<b>High Importance</b>	Drivers Conductors Owners Motorcycle and Tricycle Riders Stage Management Passengers	Environment Office Public Health Office Sacco

Response to Stakeholders require the understanding of their level of importance to and influence on the regulation of motorized road transport.

**Table 3: Necessary Intervention to Stakeholders**

	<b>Low influence</b>	<b>High Influence</b>
<b>Low importance</b>	This group may have some limited involvement in evaluation but are relatively of low priority	This group may be a source of risk and will need careful monitoring and management
<b>High Importance</b>	This group will require special initiatives to protect their interests	A good working relationship must be created with this group

Contents of the following documents were analyzed to assess their responsiveness to CO<sub>2</sub> mitigation.

1. Kyoto Protocol
2. The Paris Agreement
3. Carbon Credit and Carbon Offset Policy
4. Sustainable Development Goals (SDGs)
5. The Constitution of Kenya 2010
6. The Kenya Vision 2030
7. The Big 4 Agenda
8. The New Urban Agenda – Kenya’s Popular Version
9. National Energy and Petroleum Policy
10. National Policy on Climate Finance 2016
11. National Climate Change Action Plan 2018-2022
12. National Environment Policy 2013
13. Legal Notice No 161 of 2003
14. Sessional Paper No. 2 of 2012
15. Traffic (Amendment) Act 2012 Cap 403
16. The National Transport and Safety Authority Act 2012 Cap 275
17. Transport Licensing Act Cap 404
18. The Kenya Roads Act 2015
19. The Environmental Management and Co-Ordination Act of 1999 Cap 387
20. Kisumu County Integrated Development Plans (CIDP)

These International Agreements, policies and legislations were subjected to document analysis by the author to assess their responsiveness to general emissions, GHG emissions and CO<sub>2</sub> emissions where √ was used to show responsiveness and × to show non-responsiveness.

**Table 4: Responsiveness of Policies and Legislations to Emissions**

<b>International Agreements, Policies and Legislations</b>		<b>Addressing General Emissions</b>	<b>Addressing other GHG Emissions</b>	<b>Addressing CO<sub>2</sub> Emissions.</b>
<b>International Agreements</b>				
1.	Kyoto Protocol	×	√	√
2.	The Paris Agreement	×	√	√
3.	Carbon Credit and Carbon Offset Policy	×	√	√
4.	Sustainable Development Goals (SDGs)	√	√	√
<b>Local Policies</b>				
5.	The Constitution of Kenya 2010	√	×	×
6.	The Kenya Vision 2030	√	×	×
7.	The Big 4 Agenda	√	×	×
8.	The New Urban Agenda – Kenya’s Popular Version	√	√	×
9.	National Energy and Petroleum Policy	√	√	×
10.	National Policy on Climate Finance 2016	√	√	√
11.	National Climate Change Action Plan 2018-2022	√	√	√
12.	National Environment Policy 2013	√	√	√
13.	Sessional Paper No. 2 of 2012 (Integrated National transport Policy)	√	√	√
<b>Local Legislations</b>				
14.	Legal Notice No 161 of 2003	×	×	×
15.	Traffic (Amendment) Act 2012 Cap 403	×	×	×
16.	The National Transport and Safety Authority Act 2012 Cap 275	√	×	×
17.	Transport Licensing Act Cap 404	×	×	×
18.	The Kenya Roads Act 2015	×	×	×
19.	The Environmental Management and Co-Ordination Act of 1999 Cap 387	√	√	×
20.	Kisumu County Integrated Development Plans (CIDP)	×	×	×

Out of these 20 documents, all the 4 International Agreements (The Kyoto Protocol, The Paris Agreement, The Carbon Credit and Carbon Offset Policy and The SDGs) directly address emission specific to CO<sub>2</sub> as shown in Table 4. Kenya has already domesticated these International Agreements and is expected to enact specific laws to implement the recommendations. All the local policies in Table 4 address general emissions from motorized road transport. However, only The National Policy on Climate Finance 2016, The National Climate Change Action Plan 2018-2022, The National Environment Policy 2013 and The Sessional Paper No. 2 of 2012 (Integrated National Transport Policy) have specific provisions for CO<sub>2</sub> mitigation. The enactment and operationalization of these 4 local policies can be enhanced to mitigate against accelerating CO<sub>2</sub> emission.

Several policies and Acts of Parliament have been initiated to put control and order in the transport sector. A total of 69% of matatu operators and 72% of cycle operators confirmed to have received sensitization on road transport policies. This is an indication of a good stakeholder involvement on programmes. In terms of willingness to implement policies and laws for matatu operators and cycle riders, the responses were 72% and 78% respectively. In terms of willingness to obey policies and laws for Matatu operators and cycle riders, the responses were 92% and 79% respectively. This big percentage in willingness is a good sign of commitment and adherence to sector-specific regulations. These operators were sensitized by their Sacco agents and management who equally were sensitized by the Kisumu City policy implementors.

It is a challenge to policymakers in the Kisumu County assembly to enact laws which can specifically address the uncontrolled emission of CO<sub>2</sub> into the atmosphere at the local level. The greenhouse gas emission is a real threat to the natural environment and requires a strong political goodwill to manage. Major stakeholders were very willing to take part in transport and environmental sector reforms from policy development to implementation with an aim of improving the transport sector and the environment. These stakeholders should be seen as serious partners by both the policy developers and policymakers.

There was a strong indication from the institutional responses that transportation and environmental policies are not clearly defined. The traffic police were partially aware of the laws, policies and regulations that guide transportation. It is requisite that regular training of the police and other law enforcers on transportation matters is improved because they are the team that eventually sensitize the vehicle and cycle operators. The Kisumu City Public Health office and the Kisumu City Environment office appeared well informed of the laws, policies and regulations that guide transportation environment. This is quite encouraging because these offices are directly responsible in sensitizing the Matatu and cycle operators on environmental management issues.

The SWOT Analysis was done for the International Agreements and Local Policies which had components of CO<sub>2</sub> mitigation (Table 5)

**Table 5: SWOT Analysis of International Agreements and Local Policies**

	<b>Strengths</b>	<b>Weaknesses</b>	<b>Opportunities</b>	<b>Threats</b>	<b>Strategic Action</b>
<b>International Agreements</b>					
1. Kyoto Protocol	Has permitted CO <sub>2</sub> level	No mechanisms to compel countries to ratify	Supported by many Nations and governments	Some countries didn't ratify	Mobilize Countries to ratify
2. The Paris Agreement	Has permitted CO <sub>2</sub> level and emission financing	No mechanisms to compel countries to set targets	Supported by many Nations and governments	Some countries didn't ratify	Mobilize Countries to ratify and set own targets
3. Carbon Credit and Carbon Offset Policy	Allows controlled emission	Criteria for carbon credit qualification is long	Supported by many Nations and governments	Many countries have not initiated CDM projects	Channel more funds
4. Sustainable Development Goals	Goal 13 addresses climate action	It left countries to set own targets	Supported by many Nations and governments	Some countries have not set their targets	Devise mechanisms compelling countries to set targets
<b>Local Policies</b>					
5. National Policy on Climate Finance, 2016	Recognizes impact of accelerating CO <sub>2</sub> emission trend	Doesn't specify emission threshold	Supported by Climate Change Act, 2016, NCCAP 2013-2017, Public Finance Mgt Act 2012	Doesn't conform to new laws	Requires amendment to conform with new laws
6. National Climate Change Action Plan (NCCAP) 2018-2022	It domesticates UNFCCC into Big 4 Agenda	No mechanisms compelling county governments include it to their CIDP No emission threshold	Supported by Climate Change Act 2016, AU Agenda 2063, EAC Climate Change Policy & Strategy 2010, Lake Victoria Basin commission	County Governments have not actualized the budgeting	Amend county government act to allow infusion of national policies Specify CO <sub>2</sub> limits

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				Climate Change Adaptation Strategy &Action Plan 2018- 2023			
7. National Environment Policy, 2013	Has provision for low carbon transport	Doesn't specify emission threshold	Supported by EMCA Act 1999	Low initiative from government		Requires amendment to conform with new laws	
8. Integrated National transport Policy, 2012	Incorporates local and international best practices	Doesn't specify emission threshold	Encompasses both local and international practice	No relevant institutions created supporting legislations		Create relevant institutions for implementation	

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## CONCLUSION

The main findings in this study will be used to promote sustainable and equitable transportation practice and policy. Many nations and governments including Kenya have ratified International Agreements and enacted Local Policies aimed at mitigating the effects of CO<sub>2</sub> on climate change. The policies need strengthening and necessary supporting legislations and institutional structures coupled with proper funding to effectively operationalize.

From the analyses:

1. All the 4 International Agreements and Policies addressed CO<sub>2</sub> mitigation.
2. There were 4 local policies that directly address CO<sub>2</sub> emission from motorized road transport.
3. Major stakeholders were very willing (over 50% for all cases) to take part in transport and environmental reforms from policy development to implementation with an aim of improving the transport sector and the environment.

The SWOT Analysis of the International Agreements and the Local policies yielded the summary in Table 6

**Table 6: Summary of SWOT Analysis**

<b>Agreements and Policies</b>	<b>Strategic Action</b>
<b>International Agreements</b>	
1. Kyoto Protocol	Mobilize Countries to ratify
2. The Paris Agreement	Mobilize Countries to ratify and set own targets
3. Carbon Credit and Carbon Offset Policy	Channel more funds
4. Sustainable Development Goals	Devise mechanisms compelling countries to set targets
<b>Local Policies</b>	
5. National Policy on Climate Finance, 2016	Requires amendment to conform with new laws
6. National Climate Change Action Plan (NCCAP) 2018-2022	Amend County Government Act to allow infusion of national policies Specify CO <sub>2</sub> limits
7. National Environment Policy, 2013	Requires amendment to conform with new laws
8. Integrated National transport Policy, 2012	Create relevant institutions for implementation

From the SWOT Analysis the existing gaps were identified and the proposed actions were:

1. Mobilize more countries and nations to ratify the International Agreements.
2. Mobilize more countries and nations to set their own targets.
3. Allocate and channel more funds towards Carbon Credit and Carbon Offset.

4. Create relevant institutional framework for implementation of the National Climate Change Action Plan (NCCAP) 2018-2022.
5. Specify the CO<sub>2</sub> emission thresholds from motorized road transport in the National Climate Change Action Plan (NCCAP) 2018-2022.
6. National and County Assemblies to enact lacking legislations and amend Policies to conform with the new laws.

### **RECOMMENDATIONS**

Public transport planning is the professional discipline responsible for developing public transport systems. It is a cooperative process designed to foster involvement by all users of the public transport system through a proactive public participation process.

1. There is need for regular sensitization of transportation stakeholders including operators, consumers, policymakers and policy implementors on environmental issues related to CO<sub>2</sub> emission and green economy.
2. Create relevant institutional framework and supporting legislations for the implementation of the National Climate Change Action Plan (NCCAP) 2018-2022 together with well-established CO<sub>2</sub> emission limits.

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Transport Policies, BRT, Carbon Dioxide, Emission

**Policy** is a plan of action agreed or chosen by a political party, a business, etc. (Hornby, 2010). It is a course or principle of action adopted or proposed by an organization or individual. In this study a policy was used to mean a deliberate system of principles set by the government to guide decisions in the transport sector and achieve rational outcomes. A policy is intended to reach a long-term goal and is typically published in a booklet or other form that is widely accessible.

**BRT** is an abbreviation for Bus Rapid Transport. It is a bus-based public transport system designed for the improvement of reliability, capacity and speed coupled with flexibility and affordability.

**Carbon Dioxide, CO<sub>2</sub>** is a naturally occurring chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in gaseous state.

**Emission** is the production or sending out of light, heat, gas, etc. (Hornby, 2010). CO<sub>2</sub> emission is therefore the sending out of CO<sub>2</sub> into the atmosphere. Here it was used to refer to the release of CO<sub>2</sub> into the atmosphere by Public Service Vehicles that use gasoline or diesel.