THE POLICY AND INSTITUTIONAL LANDSCAPE FOR ECO-INNOVATION IN AFRICA

Technical Report

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Date:
28th April 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

ACKNOWLEDGEMENT

The African Technology Policy Studies Network (ATPS) takes this opportunity to thank all the ATPS National Chapter Coordinators, the lead researchers and facilitators who sacrificed during the COVID-19 pandemic to ensure that this study was successfully conducted. We also thank the respondents from the study countries for their inputs. Special thanks to the RECIRCULATE project community for their inputs and support throughout the study period. The ATPS team also thanks the RECIRCULATE Managers for their technical inputs and support during the study period. RECIRCULATE is funded by UK Research & Innovation through the Global Challenges Research Fund Grant Ref.: ES/P010857/1.

ACRONYMS AND ABBREVIATIONS

AEA	Agricultural Extension Agent
AGI	Association of Ghana Industries
ATPS	African Technology Policy Studies Network
AU	African Union
BCCRP	Botswana Climate Change Response Policy
BNARI	Biotechnology and Nuclear Agriculture Research Institute
BUSAC	Business Sector Advocacy Challenge Fund
CAADP	Comprehensive Africa Agriculture Development Programme
CBPA	Community-Based Participatory Approach
CER	Certified Emission Reduction
CIC	Ghana Climate Innovation Centre
CIEB	Components Implementation Entities and Beneficiaries
CITES	Convention on International Trade in Endangered Species
CSIR	Council for Scientific and Industrial Research
CTCN	Climate Technology Centre and Network
DADs	District Agricultural Departments
EAC	East African Community
ECOPOST	ECOWAS Policy on Science and Technology
ECOWAP	Economic Community of West African States Agricultural Policy
ECOWAS	Economic Community of West African States
EIO	Eco-innovation Observatory
EPA	Environmental Protection Agency
EPC	Environmental Protection Council
ESP	Environmental Sanitation Policy
EU	European Union
FASDEP	Food and Agriculture Sector Development Policy
FIT	Feed-In-Tariff
GATT	General Agreement on Trade and Tariff s
GDP	Gross Domestic Product
GEPC	Ghana Export Promotion Council
GERD	Gross Expenditure on Research and Development
GFZB	Ghana Free Zones Board
GHG	Green House Gas
GHG	Greenhouse gas
GII	Global Innovation Index
GIPC	Ghana Investment Promotion Centre
GSA	Ghana Standard Authority
HDI	Human Development Index
ILO	International Labour Organization
KAM	Kenya Association of Manufacturers
LUPSA	Land Use and Spatial Planning Authority
LULUCF	Land Use, Land Use Change and Forestry
MESTI	Ministry of Environment, Science, Technology and Innovation
MMDAs	Metropolitan, Municipal and District Assemblies
MoFA	Ministry of Food and Agriculture

MoAIWD	Ministry of Agriculture, Irrigation and Water Development
MoITPW	Ministry of Transport and Public Works
MTNDPF	Medium-Term National Development Policy Framework
MTP	Medium Term Plan
NAP	National Adaptation Plan
NBSAP	National Biodiversity Strategy and Action Plan
NBSSI	National Board for Small Scale Industries
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
NCST	National Commission for Science and Technology, Malawi
NDCs	Nationally Determined Contributions
NDRF	National Disaster Recovery Framework
NDPC	National Development Planning Commission
NEP	National Environmental Policy
NEPAD	New Partnership for Africa's Development
NIS	National Innovation System
NNRI	National Nuclear Research Institute
NSC	National Steering Committee
NSTC	National Science and Technology Council, Zambia
NTCCC	National Technical Committee on Climate Change
NWP	National Water Policy
OECD	Organization for Economic Cooperation and Development
PACSTI	Presidential Advisory Council on Science, Technology and Innovation
PURC	Public Utilities Regulatory Commission
RADs	Regional Agriculture Departments
REMP-CU	REMP Coordinating Unit
RETs	Renewable Energy Technologies
SADC	Southern Africa Development Community
SDGs	Sustainable Development Goals
SGCs	Science Granting Councils
SMEs	Small and Medium Enterprises
SNEP	Strategic National Energy Plan
SPRU	Science Policy Research Unit
STEM	Science, Technology, Engineering and Mathematics
STEPRI	CSIR-Science and Technology Policy Research Institute
STI	Science, Technology and Innovation
STISA	Science, Technology and Innovation Strategy for Africa
SWGs	Sector Working Groups
TIP	Transformative Innovation Policy
TIPC	Transformative Innovation Policy Consortium
TUDRIDEP	Tumu Deanery Integrated Development Programme
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WRC	Water Resources Commission
WTO	World Trade Organisation
ZEMA	Zambia Environmental Management Agency

EXECUTIVE SUMMARY

The world is facing growing concerns about the state of the natural environment due to the negative impacts of greenhouse gas (GHG) emissions, inefficiency in natural resource use and waste management as well as the devastating impacts of pollution. All these challenges culminate in water, energy and food insecurity concerns and have serious implications for biodiversity. The rising prominence of these natural environmental challenges has triggered global and local policy adjustments, as well as industry initiatives to stymie these challenges. Examples of such initiatives include the establishment of Sustainable Development Goals (SDGs) by the United Nations (UN) in 2015. The seventeen (17) SDGs are a global attempt, led by the UN, to direct the world towards sustainable development. The African Union (AU) developed the Science, Technology and Innovation Strategy for Africa (STISA), 2024 as part of the "*Agenda 2063 (The Africa We Want)*" with a mission to accelerate Africa's transition to an innovation-led, knowledge-based economy using Science, Technology and Innovation (STI). This strategy document recognizes the contribution STI can make in achieving the AU goals. The AU urged its Member States to improve STI readiness in terms of infrastructure, professional and technical competence, and entrepreneurial capacity and implement specific policies and programs in STI that address societal needs holistically and sustainably. To meet the targets of sustainable development, industrial activities should be undertaken within the threshold of the natural environment, vis-à-vis sustainable development.

Various concepts have been advanced in the past that focus on promoting sustainable development with emphasis on reducing emissions to promote a green economy, green growth, or sometimes referred to as green innovation. This shift focused mainly on using renewable energy sources, reduction of utilization of fossil fuels as well as developing resource-use efficient technologies. "*Transitioning to an inclusive green economy based on sustainable consumption and production patterns requires new sustainable business strategies and models and a supportive policy framework. Creating new sustainable business strategies and models in response to environmental, economic and social challenges is a process of Eco-innovation. By applying life cycle thinking and engaging with partners across the value chain, Eco-innovation helps to incorporate sustainability into business decision-making and to develop new business strategies, models and products. Eco-innovation provides a competitive advantage to business by creating win-win opportunities for economic development, positive impact on society and reducing harm to the environment"* (UNEP, 2017). Reid and Miedzinski (2008), defined Eco-innovation as "*the creation of novel and competitively priced goods, processes, systems, services, and procedures designed to satisfy human needs and provide a better quality of life for everyone with a whole-life-cycle minimal use of natural resources (materials including energy and surface area) per unit output, and a minimal release of toxic substances*."

The concept of Eco-innovation seems new in many African countries. Different regions and countries have embraced different aspects of sustainable development and green economy. The RECIRCULATE program provides a promising elucidation for tackling such challenges in Africa, by driving Eco-innovation through capacity building for a safe circular water economy. This is because it supports high quality and results-oriented research partnerships that offer sustainable solutions to water use and safety problems. This offers a life-long solution thus shifting the production frontier from a resource-dependent to a knowledge-based level. It is based on this that the program commissioned an in-depth review and analysis of existing relevant policies and

institutional landscapes related to Eco-innovation development in the six (6) RECIRCULATE participating countries namely: Botswana, Ghana, Kenya, Malawi, Nigeria and Zambia. The study aimed to decipher what works (successes), what does not work (failures) and why (reasons for successes or failures). The study considered all Eco-innovation related policies and strategic frameworks across various sectors including Agriculture, Environment & Natural resources, Energy, Trade & Industry, Transport and Science, Technology and Innovation (STI). The policy review and analysis cut across continental (Africa), regional and national levels of governance.

The study used both primary and secondary data collection methods. The secondary data and information were obtained through comprehensive desk studies, where published policy materials, online journals and all relevant grey literature were reviewed and analysed. The primary data were obtained through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) with Eco-innovation relevant stakeholders from the study countries. The selected key informants and FGD participants were sought from different categories of stakeholders including relevant government (public) policymakers, the private sector, Civil Society Organizations (CSOs), Research and Development institutions and the media. At least one FGD and twenty (20) KII were conducted in each of the study countries. All aspects of Eco-innovation were considered including sustainable and ecological organic agriculture, bio-economy, green growth, green and renewable energy sources, soil and water conservation, recycling of waste, conservation of indigenous forestry, transportation, industry, and health among others, along the value chain from production to consumption. Additionally, all institutions implementing the Eco-innovation related policies and strategic plans, or supporting any aspect of Eco-innovation development and its sustainability were also identified and mapped.

The findings reveal that none of the study countries has a stand-alone Eco-innovation policy but Eco-innovation principles are implied in the numerous existing sectoral policies that underpin Eco-innovation. The constitutions of most of the countries have strong emphasis on most of the Eco-innovation principles. The Agriculture, Environment & Natural Resources (Water, Forestry & Mining included), STI, Energy, Trade & Industry and Transport are among the key sectors cutting across the study countries that have Eco-innovation related policies, principles, practices and strategies. On the institutional front, all the study countries have put in place structures that generate technologies and innovations that are aimed at addressing their respective national development challenges. It is under these structures that Eco-innovation can be anchored. All the countries studied already recognize that STI is critical in steering development by generating innovative solutions that will enhance productivity as well as ensure environmental sustainability.

Several enablers of Eco-innovation were identified. These include the presence of policies and institutions that support STI in all the study countries. There is very strongly expressed political will from all the countries to support innovation-related programmes in the countries. Continental and Regional strategies to promote STI in Africa have also been embraced by all the study countries and efforts are underway to align their national development plans along those of the continental and regional bodies. For instance, the East Africa Commission (EAC) is in the process of developing an East African Bio-economy strategy that will address pertinent issues in line with Eco-innovation. The constrainers to Eco-innovation identified include undiversified production structures that concentrate on the production of primary commodities without value addition, unskilled and semi-skilled human resources, weak governance that leads to corruption and misuse

of public resources, enormous social inequalities, overdependence on agriculture and natural resources as the key contributor to GDP among others. Further, all the study countries are party to the different global environmental initiatives such as the United Nations Convention on Climate Change (UNFCCC), the Kyoto Protocol, the Paris Agreement, among others that are aimed at enhancing environmental conservation, combating climate change through the reduction of greenhouse gas emissions as well as promoting the circular/green economy. Concerning the Paris Agreement, all the study countries have submitted their Nationally Determined Contributions (NDCs) and most of them are on course in terms of putting structures in place to begin implementation. These conventions/agreements are in line with some important aspects of Eco-innovation and therefore, implementation of these would go a long way in enhancing the capacity as well as improving the infrastructure of anchoring Eco-innovation in these countries.

In most of the study countries, the production and consumption of goods and services are predominantly linear in the sense that resources are extracted, processed, used and disposed as waste. This trend is risky given the rate of population increase and demand for the limited natural resources. As a mitigation strategy, African economies must realign their development policies and strategic plans with sustainable developments aspects like promotion of bio-economy, green growth, ecological organic and sustainable agriculture practices, use of green and renewable energy among other technologies of Eco-innovation and circular economy.

The policy and institutional landscape in the study countries have had different impacts as far as Eco-innovation is concerned. These have been documented throughout the report as case studies and initiatives as well as in the analytical sections discussing the successes, failures and reasons for those successes and failures. The Global Innovation Index (GII) 2019 ranked the study countries differently based on the various indicators that range from the political environment, education, infrastructure and business sophistication. Kenya was ranked 2nd after South Africa in sub-Saharan Africa, while Botswana was ranked 4th, Ghana 11th, Nigeria 14th, Malawi 17th and Zambia 22nd. Although the ranking criteria did not target Eco-innovation per se, most of the indicators are consistent with what Eco-innovation stands for and, therefore, can be used to gauge progress countries make towards developing systems that support Eco-innovation in their respective countries.

It was also revealed that the performance of the study countries in the implementation of STI and Eco-innovation related policies vary based on various factors such as the Natural, Social, Financial/Economic, Physical, Human and Political Capital. Countries that have a good balance of these capitals outperform the rest. For instance, Botswana is well endowed by Natural resources, has a good GDP per capita, has invested admirably in STI, research and education and has a supportive political environment. These have contributed significantly to the progress so far achieved by Botswana based on the GII ranking and other relevant indicators of progress. It is fundamental for the study countries to have a National STI policy and their accompanying strategies and plans. These will provide a clearer impact pathway for the development and implementation of Eco-innovation. It has also been demonstrated that sufficient funding through the establishment of a national research fund has worked well in the countries that have it. Also, investment in the STI infrastructure, having a national coordinating institution and developing the capacity of its staff has worked well in Kenya. Political will and support for STI are very crucial as Government holds the key to unlocking the required resources to support Eco-innovation. There

is a strong political commitment from the study countries for years. In Ghana, for instance, the first President the late Kwame Nkurumah led the country and the African continent in supporting Science and Technology as a means for development in Africa.

In order to enhance Eco-innovation in the study countries, there is need to strengthen the already existing STI policy and institutional landscape. The STI implementation infrastructure provides a basis to anchor Eco-innovation and tweak the focus in the generation and use of STI to accommodate Eco-innovation principles. The development of Strategies, Guidelines and Regulations that accompany the policies is also critical. The current policies need to be re-oriented to support Eco-innovation activities across different sectors. The policies and institutions should consider a holistic view of Eco-innovation, not only focussing on the resource utilization but the entire life cycle process, including re-use and recycling. Incentives such as tax relief should be given to outstanding eco-innovators and entrepreneurs to motivate them. Environmental standards should also be set upon which production processes are assessed to ensure adherence to Eco-innovation principles. These call for the:

- Increasing investment in Eco-innovation research and development
- Development of structures that provide incentives for Eco-innovation and discourage environmentally unfriendly processes
- Enactment of stringent policies and laws that support Eco-innovation
- Improvement of policy alignment around Eco-innovation and strengthen coordination
- Increasing political goodwill to develop Eco-innovation policy at the continental, regional and national levels.
- Mainstreaming Eco-innovation into the curricula of educational institutions in Africa
- Strengthening national institutions with the capacity to adequately implement Eco-innovation policies and programs
- Investing in the necessary infrastructure, equipment and human resource capacity to support Eco-innovation
- Awareness creation and advocacy in support of Eco-innovation development in government policies and programs
- Development of robust indicators for measuring Eco-innovation in liaison with international standards organizations

1. INTRODUCTION

1.1 Background

The world today is facing growing concerns about the state of the natural environment due to the negative impacts of greenhouse gas (GHG) emissions, inefficiency in natural resource use and waste management as well as the devastating impacts of pollution among many others. All these challenges culminate into water, energy and food insecurity concerns and have serious implications for biodiversity. The majority of African countries derive a substantial share of their Gross Domestic Products (GDPs) from natural resource-dependent sectors such as agriculture, mining, forestry, water, energy, transport and aquaculture (OECD/FAO, 2016). This implies that the economies are sensitive to changes in the existing natural resource base, thus exposing their population to the risks associated with natural calamities and other exogenous factors such as climate change. The rising prominence of these natural environmental challenges has triggered global and local policy adjustments, as well as industry initiatives to stymie these challenges (Munodawafa and Johl, 2019). Examples of such initiatives include the establishment of 17 Sustainable Development Goals (SDGs) by the United Nations (UN) in 2015. These 17 SDG goals are a global attempt, led by the United Nations, to direct the world towards sustainable development (Hajer et. al., 2015).

According to the United Nations (2015) report, corrective action needs to be taken if humanity is to avert an imminent natural environmental crisis. Remedial and preventive actions will help ensure the continuous, uninhibited operation of the biosphere, which serves both as a provider and a sink for emissions. There have been various efforts that are being implemented to ensure sustainable development that focus on satisfying present needs without negatively impacting future generations' ability to satisfy their own needs. To meet the targets of sustainable development, industrial activities should be undertaken within the threshold of the natural environment, vis-à-vis sustainable development (Munodawafa and Johl, 2019). For industry to usher in sustainable development, organizations need to shift from focusing solely upon profit but continue their pursuit of profit without neglecting the interests of the planet and people, as the protection of the biosphere will influence current and future competitiveness for organizations (Stock et. al., 2018).

Various concepts have been advanced in the recent past that focus on promoting sustainable development with emphasis on reducing emissions to promote a green economy, green growth, or sometimes referred to as green innovation. This shift focused on using renewable energy sources, reduction of utilization of fossil fuel as well as developing resource-use efficient technologies. "*Transitioning to an inclusive green economy based on sustainable consumption and production patterns require new sustainable business strategies and models and a supportive policy framework. Creating new sustainable business strategies and models in response to environmental, economic and social challenges is a process of Eco-innovation. By applying life cycle thinking and engaging with partners across the value chain, Eco-innovation helps to incorporate sustainability into business decision-making and to develop new business strategies, models and products. Eco-innovation provides a competitive advantage to business by creating win-win opportunities for economic development, positive impact on society and reducing harm to the environment"* (UNEP, 2017).

The concept of Eco-innovation seems new in many African countries. According to Reid and Miedzinski (2008), Eco-innovation is defined as "the creation of novel and competitively priced goods, processes, systems, services, and procedures designed to satisfy human needs and provide a better quality of life for everyone with a whole-life-cycle minimal use of natural resources (materials including energy and surface area) per unit output, and a minimal release of toxic substances." Different regions and countries have embraced different aspects of sustainable development and green economy. In the more developed continents, new technologies, designs, services and innovations are contributing to the circular economies. The deterioration of ecological systems—locally, nationally, and globally-demands economic solutions that will enable their restoration. This calls for more radical and systemic innovations necessary to transform the traditional resource-wasting production and consumption patterns into economic systems characterized by the circular flow of natural resources, which is an aspect of Eco-innovation. A circular economy entails two key attributes that can be considered "hardware" and "software." The "hardware" aspect comprises the Eco-innovative technologies and technical infrastructures that would allow the conversion of waste into reusable resources again. The "software" aspects are the Eco-innovative skills, expertise and business models that would turn these transformations into lucrative business opportunities.

In most African countries, the production and consumption of goods and services are predominantly linear in the sense that resources are extracted, processed, used and disposed as waste. This trend is risky given the rate of population increase and demand for the limited natural resources. As a mitigation strategy, African economies must realign their development policies and strategic plans with sustainable developments aspects like promotion of bio-economy, green growth, ecological organic and sustainable agriculture practices, use of green and renewable energy among other technologies of Eco-innovation and circular economy.

1.2 Rationale

In the face of the increasing human population, the developing world has been facing a myriad of inter-dependent challenges ranging from social, economic and environmental challenges. The environmental safety threshold has been surpassed as evidenced by the ecological problems emanating from the overuse and misuse of natural resources like climate change, desertification, food and water insecurity, widespread of environment-related human diseases, soil degradation, and natural catastrophes like floods and hurricanes (Reid and Miedzinski, 2008). With new technologies and innovations, these environmental challenges offer a potential boom in the industry sector, especially in the developing world. However, this calls for scientific research geared towards formulating sustainable and implementable national, regional and continental policies and strategic plans.

The RECIRCULATE program provides a promising elucidation for tackling such challenges in Africa, by driving Eco-innovation through capacity building for a safe circular water economy. This is because it supports high quality and results-oriented research partnerships that offer sustainable solutions to water use and safety problems. This offers a life-long solution thus shifting the production frontier from a resource-dependent to a knowledge-based level.

1.3 Objectives and scope of the study

An in-depth review and analyses of the existing relevant policies and institutional landscapes related to Eco-innovation development were conducted in the six (6) RECIRCULATE participating countries namely: Ghana, Nigeria, Kenya, Malawi, Botswana and Zambia, to understand what works (successes), what does not work (failures) and why (reasons for successes or failures). The study considered all Eco-innovation related policies and strategic frameworks across various sectors like agriculture, environment & natural resources, forestry, trade & industry, transport and science, technology and innovations (STI). The policy review and analysis cuts across continental (Africa), regional and national levels of governance.

All aspects of Eco-innovation were considered in these policy frameworks including sustainable and ecological organic agriculture, bio-economy, circular economy, green growth, green and renewable energy sources, soil and water conservation, recycling of waste and the conservation of indigenous forestry among others, along their value chains from production to consumption. Additionally, all institutions implementing the Eco-innovation related policies and strategic plans, or supporting any aspect of Eco-innovation development and its sustainability were also identified. Within these institutions, all actors and stakeholders supporting Eco-innovation practices and technologies were mapped for targeted intervention programmes.

2. METHODOLOGY

This study used both primary and secondary data collection methods. The secondary data and information were obtained through comprehensive desk studies, where published policy materials, online journals and all relevant grey literature were reviewed and analysed. The primary data were obtained through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) with Eco-innovation relevant stakeholders from the focus countries. The selected key informants and FGD participants were sought from relevant government (public) policymakers, the private sector, Civil Society Organizations (CSOs), research and development institutions and the media. At least one FGD and twenty (20) KII were conducted in each of the six (6) RECIRCULATE countries.

The KII and FGD questions focused on understanding the existing enabling and/or constraining Eco-innovation policy environments in the specific areas, the existing policy gaps as well as their proposed recommendations to ensure the sustainability of Eco-innovation in those countries, the roles of the institutions and actors in promoting Eco-innovation, whether there were linkages between them and across sectors, the progress made, challenges, opportunities and benefits attained in promoting Eco-innovation.

3. FINDINGS AND DISCUSSIONS

This chapter provides findings of the study detailing policies and institutions that are promoting Eco-innovation in the study countries. The continental and regional level policies and institutions have also been discussed. This chapter begins by covering the global and regional perspectives on Eco-innovation as well as providing enablers and constrainers to the implementation of Eco-innovation.

3.1 Global and Regional Perspectives on Eco-innovation

This section provides an understanding of Eco-innovation at various levels of governance from a global perspective to an African perspective.

3.1.1 Broad conceptualization of Eco-innovation concept

"*Decoupling economic growth from the consumption of natural resources, environmental degradation and adverse impact on the global climate is one of the greatest challenges in the 21st century*" (GIZ, 2014). Embracing Eco-innovation /green innovations can be one of the reliable and long-term solutions to this global challenge. While some countries have made a considerable milestone in inventing environmental technologies and innovations aimed at tackling environmental challenges and increasing the efficiency in the utilization of natural resources, the overall progress in greening the global economy has been modest.

"*Most OECD countries consider Eco-innovation as an important part of the solution to contemporary challenges like climate change and energy security*" (OECD, 2009). Also, they consider Eco-innovation as "*a source of competitive advantage in the face of the growing environmental goods and services sector*" (OECD, 2009). In the European Union (EU), more Eco-innovation attention has been focused on the manufacturing sector. A survey by Eurobarometer (2011), revealed that around 76% of organizations in the EU have introduced a product, process or organizational Eco-innovation. A total of 41% of those organizations spent more than 10% of their innovation budgets on Eco-innovation, while 16% invested over 30% of their innovation budgets on Eco-innovation. Some of the Eco-innovations adopted include less raw material usage; less energy usage; minimizing carbon dioxide (CO_2) footprint of the companies; using non-polluting materials; and decreasing soil, water and air pollution among others.

In the United States, the terms "Environmental innovation" and "clean technology" are often used to mean Eco-innovation. The Environmental Protection Agency refers to environmental innovation as outcomes from result-oriented and collaborative endeavours within the sector. Emphasis is on both the regulatory approaches as well as the technological aspects of environmental protection. Innovative regulatory systems include pilot testing of flexible air permits, offering regulatory incentives for environmental protection and innovative ways to regulate small businesses.

In Africa, different countries support Eco-innovation in different ways. For instance, in South Africa, emphasis on Eco-innovation is three-tiered. First, support innovations that protect the environment. Second, is innovation on regulatory approaches and standards and finally, is the focus on the impact of Eco-innovations as prioritized in the national sustainable development plans.

Although South Africa does not have a stand-alone policy on Eco-innovation, it seems to be the only African country where Eco-innovation is implicitly addressed in various national policies and strategic frameworks promoting research and development for sustainable development (OECD, 2011).

3.1.2 Global and Regional Enablers and/or Constrainers of Eco-innovation

The Eco-innovation capacity of different regions and continents is determined by general factors typical to all innovative activities as well as environmentally specific factors. This implies that different areas have different area-specific factors that drive or hamper Eco-innovation. Therefore, it is important to identify the drivers and barriers of Eco-innovation, to unfold its potentials. Drivers/enablers of Eco-innovation refers to those specific and evident factors that promote Eco-innovation or diminish the pressure exerted on the environment by human activities. On the other hand, barriers/constrainers of Eco-innovation are the market imperfections that hinder the adoption of Eco-innovation (Bleischwitz et al., 2009). The drivers and barriers of Eco-innovation can either be internal or external to the entities or organizations.

Identification and analysis of these drivers and barriers are crucial for policymakers to make viable Eco-innovation policies and development plans and also offer the necessary support to the implementers of the Eco-innovations. Globally, there is profound public policy support in the energy arena, where attention has been directed to green and renewable energy sources as a key factor in reducing greenhouse gas emissions and combating climate change. For instance, the UK debate on Eco-innovation and sustainability challenges has been dominated by serious concerns on energy and climate change, as key areas for low-carbon innovations. A key theme to this debate has been the ability of the UK to participate and dominate in the global value chains for low-carbon technologies.

The UK's ability to dominate in the low-carbon technologies has been enabled by its supportive legal, regulatory and policy environment, as set out in its comprehensive low carbon transition plan to 2020 that aims to cut emissions by 80% by 2050. The UK has a strong scientific research base, expertise in high-value service and financial industries that provide long-term support and direction to the Eco-innovation technologies (the UK's draft National Energy and Climate Plan, 2019). The UK's government has put in place various strategies to promote and support the transition to low-carbon emissions such as offering interest-free loans to organizations that invest in greater energy or resource efficiency, transforming its energy infrastructure to accommodate renewable technologies like micro-generation, equipping its workforce with the necessary skills to take up the opportunities offered by the green economy, creating demand for the low carbon products through informing the consumers and incentivizing them and creating a climate-resilient economy.

In Africa, Eco-innovation as a concept is still in its infancy stages with little public policy support. Nevertheless, Eco-innovation practices, principles and ideas abound in the different sectors of the economy. Some factors favour the development and sustainability of Eco-innovation in Africa.

These include the abundance of untapped renewable natural resources such as solar, wind and even geothermal; the emergence of numerous development partners for African nations such as China, India and Brazil, which may offer more opportunities for the continent, thus renewing its interest and commitment to sustainable and Eco-innovation practices; the untapped potential of people/nations mobilizing domestic resources; and the rise in capital inflows such as increased remittances that offer the continent a golden opportunity to increase Eco-innovation developments. Besides, most African countries have a youthful population that provide the required labour force in driving Eco-innovations, such as agroforestry (Eco-innovation Observatory [EIO], 2016).

On the other hand, the continent faces a myriad of factors that constrain its Eco-innovative ability. Foremost, the majority of African countries and economies have undiversified production structures that concentrate on the production of primary commodities without value addition (Mendes et al., 2014). These countries also have the largest number of unskilled and semi-skilled human resources compared to other economies around the globe. The continent is also known for its weak governance, leading to corruption and misuse of public resources. Enormous social inequalities across the continent are a big hindrance to the innovativeness of its youth and women. Additionally, most of the countries are highly dependent on agriculture as the key contributor to GDP growth which is under threat given the effects of climate change and water insecurity on the continent. All African countries face a great challenge in innovation due to poor infrastructure and energy insecurity (EIO, 2016) and other competing priorities such as education and poverty.

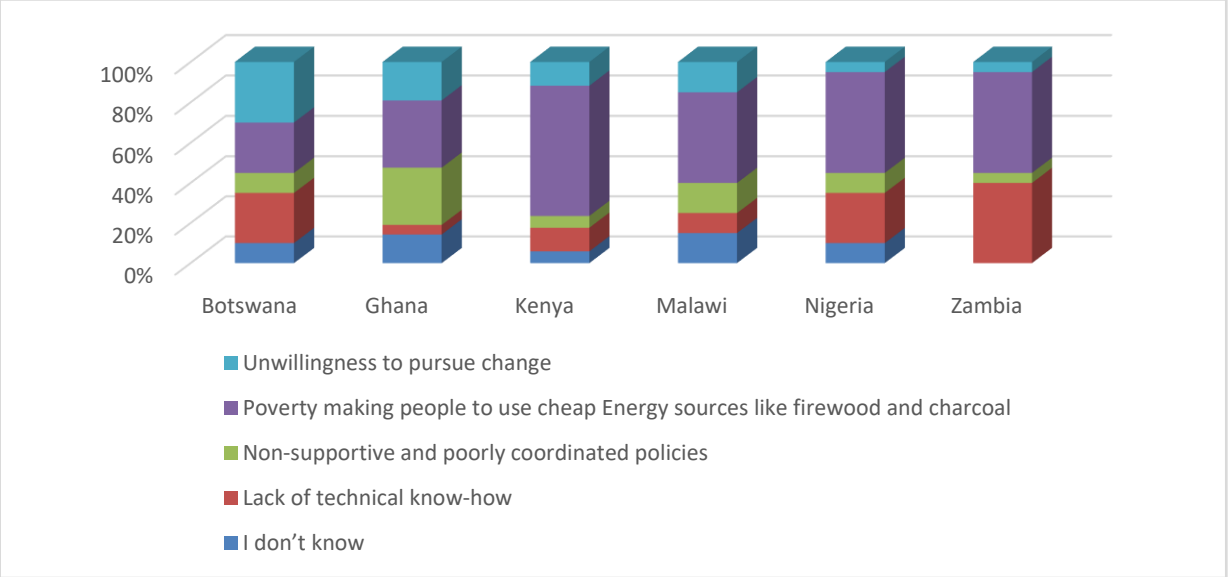


Figure 1: Barriers to Eco-innovation as perceived in the study countries

Figure 1 above shows the perception of respondents in the different study countries on the barriers to Eco-innovation. The survey findings show that poverty is the major barrier that has for instance led to overdependence on firewood and charcoal. In Botswana, 25% of the respondents said that the main barrier was the lack of technical know-how, 10% of the respondents said that non-supportive and poorly coordinated policies were the major barriers to Eco-innovation while 30% of the respondents said that unwillingness to pursue change was the main barrier to Eco-innovation.

In Ghana, 33.3% of the respondents indicated that poverty was the main barrier while 29% of the respondents indicated that non-supportive and poorly coordinated policies were barriers to Eco-innovation. In Kenya, 64.7% said that the main barrier to Eco-innovation was poverty while 11.8% of the respondents thought that the main barrier was the unwillingness to pursue change. The majority of the respondents (45%) in Malawi also agreed that poverty was the main barrier while 15% indicated that unwillingness to pursue change was one of the major Eco-innovation barriers. However, respondents interviewed in Botswana, Nigeria and Zambia had response rates of 20%, 25% and 40% respectively who felt that lack of technical know-how was the major Eco-innovation barrier.

3.1.3 Global and Regional Eco-innovation related policy frameworks

The achievement of the ambitious 2030 Agenda for sustainable development requires new and innovative approaches that are socially inclusive, economically sustainable and environmentally benign (UNCTAD, 2017). In recent decades, the expansion of economic activities across the globe has been coupled with growing concerns over various environmental issues such as climate change, food, water and energy insecurity as well as resource scarcity. In response, different sectors of the economy have shown more interest to venture into sustainable production technologies and practices that are more efficient and productive, which is a process of Eco-innovation. "*Transitioning to an inclusive green economy based on sustainable consumption and production patterns also require sustainable business models and strategies and supporting policy frameworks*" (UNEP, 2017).

Globally, the UK is at the forefront in the formulation and implementation of "green" or "clean" technologies (EIO, 2015). Being advanced in industrialization, it has put in place various policy tools and frameworks to guide and support environmentally benign practices. For instance, the UK's Low Carbon Industrial Strategy aims to ensure that the British businesses and workers are well equipped to meet the growing markets for low carbon goods and services. This is achieved through efficient use of energy and other resources, thus reducing their costs and maximizing economic opportunities. This strategy proposes the allocation of a substantial share of public funds to support low carbon industries and advanced green manufacturing.

United Nations Framework Convention on Climate Change (UNFCCC), ***the Kyoto Protocol*** and ***the Paris Agreement 2015***- The international community's efforts to combat adverse effects of climate change can be traced from the promulgation of the United Nations Framework Convention on Climate Change (UNFCCC) and its related implementation mechanisms, including the Kyoto Protocol (KP) and Conference of Parties (COP) decisions, which all the study countries are party to. The process of defining a common ground for all the Parties has translated through negotiations into climate change response mechanisms addressing both socio-economic and policy considerations. There is a general willingness to protect the human and natural systems from global warming with meaningful adaptation and mitigation measures that require national responses through policies, strategies and action plans. Whereas the KP prescribes mitigation targets for developed countries, UNFCCC requires developing countries to adopt policies that would enhance their adaptation capacities and capabilities as well as non-legally binding mitigation measures. Meanwhile, the Paris Agreement was adopted in 2015 to address climate change and its negative impacts. The deal aims to substantially reduce global greenhouse gas emissions to limit the global temperature increases in this century to 2 degrees Celsius above preindustrial levels while pursuing

means to limit the increase to 1.5 degrees. The agreement includes commitments from all major emitting countries to cut their climate-altering pollution and to strengthen those commitments over time. The pact provides a pathway for developed nations to assist developing nations in their climate mitigation and adaptation efforts, and it creates a framework for the transparent monitoring, reporting, and ratcheting up of countries' individual and collective climate goals[1]. These targets have been set up in form of NDCs where countries have set goals to be achieved within the set timelines. Some of these targets include the enactment of climate change policies as national response frameworks for directly addressing existing and potential climate change impacts, and for integrating climate change into development planning and implementation.

Global Environment Facility (GEF)[2] was established one year leading up to the 1992 Rio Earth Summit. It is a global partnership that gives developing countries funding for innovative projects that generate worldwide environmental benefits. Over three decades, the GEF has provided over US$17.9 billion in grants and mobilized an additional US$ 93.2 billion in co-financing for more than 4,500 projects in 170 countries. The GEF has also grown into a partnership of 183 countries, international institutions, civil society organizations, and the private sector—all committed to addressing the world's environmental issues.

The UK Low Carbon Transition Plan of 2009 sets out the government's plan to cut carbon emissions by the end of the year 2020. This White Paper aims to transform various sectors like the power sector, transport, homes and workplaces and farming to meet specific carbon budgets, secure energy supplies, maximize economic opportunities and protect vulnerable consumers (HMG, 2009). Since carbon emission constitutes a big share of greenhouse gases, their reduction plays a critical role in reducing global warming and the associated economic and environmental challenges, thus expressing this plan's support for green growth.

In Europe, ***the EU 2020 strategy,*** also known as the ***Strategy for smart, sustainable and inclusive growth,*** prioritizes the development of an economy based on knowledge and innovation (smart growth), promoting a more resource-efficient, greener and more competitive economy (sustainable growth), and fostering a high employment economy yielding social and territorial cohesion (inclusive growth). Further, the European Commission has adopted a *Circular Economy Action Plan*[3] - one of the main blocks of the European Green Deal, Europe's new agenda for sustainable growth. The new Action Plan announces initiatives along the entire life cycle of products, targeting their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible. It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value. The new Circular Economy Action Plan presents measures to make sustainable products the norm in the EU; empower consumers and public buyers; focus on the sectors that use most resources and where the potential for circularity is high such as electronics and Information Communication Technology (ICT); batteries and vehicles; packaging; plastics; textiles; construction and buildings; food; water and nutrients; ensure less waste; make circularity work for people, regions and cities, and Lead global efforts on the circular economy.

[1] https://www.nrdc.org/stories/paris-climate-agreement-everything-you-need-know#sec-whatis
[2] https://www.gov.ph/web/green-climate-fund/global-environment-facility
[3] https://ec.europa.eu/environment/circular-economy/

In the United States, ***the National Bio-economy Blueprint of 2012*** is a policy document that paves way for current and future bio-economy discourse while relying on past policies ad strategies. It is anchored on applications of genetic engineering, manipulations of bio-molecules and DNA sequencing as a vehicle to drive sustainable development in health, agriculture and the environment. This is in tandem with research and innovation and efficient use of bio-resources, which are key constituents of Eco-innovation.

African countries lack dedicated Eco-innovation policies and targets, with the majority of Eco-innovation related policies framed around sustainable development. Most environmental-related innovations are mainly addressed through environmental policies. Additionally, different African countries have adopted various energy policies to promote cleaner and renewable energy sources, like solar energy (Ambali et. al., 2011). Though the continent has been lagging policy-wise in its support for Eco-innovation, various policy instruments have been formulated to guide and support different aspects of Eco-innovation.

The Africa Bioenergy Policy Framework and Guidelines, adopted in 2013, aims to build a consensus on shared frameworks that inspire and guide individual countries in developing policies and regulations, as well as enhancing awareness among African leaders and the civil society on the need for environmentally friendly bioenergy development policies across the member states (AUC and UNECA, 2013). This strategy advocates for the adoption and use of bioenergy as a viable and sustainable solution to the escalating social and environmental challenges in Africa such as the depletion of biodiversity, water resources and soil degradation among others. Moreover, it proposes the integration of the bioenergy sector with other poverty reduction policies and global processes at the national and regional levels, thus supporting Eco-innovation.

The Science, Technology and Innovation Strategy for Africa (STISA -2024), was formulated by the African Union in 2014. This strategy did not explicitly mention Eco-innovation in its priority areas. However, it responds to the need for Africa to transform into a knowledge-based and innovation-led society. Among its priority areas is the eradication of hunger and achieving food security which should be dealt with through the application of climate change mitigation practices, water and land management. The strategy also advocates for environmental and biodiversity protection as a way of protecting our space. It also recognizes the need to conserve our natural resources for wealth creation. On the African bio-economy frontier, South Africa takes the lead with the National Bio-economy Strategy, 2013. The strategy focuses on agriculture, health, industries and environmental innovation while incorporating indigenous knowledge system to conserve and maintain biodiversity, thus supporting Eco-innovation in Africa (Bracco et. al., 2018).

The Comprehensive Africa Agriculture Development Programme (CAADP), launched in 2003 is a common agricultural policy aimed at spurring sustainable agricultural growth across the continent. Its goal is to help African countries reach a higher path of economic growth through agriculture-led development. This is attained by eliminating hunger in the continent, reducing poverty and food insecurity and expanding exports. It was meant to ensure that the countries practice environmentally sound production methods and maintain a culture of sustainable management of the available natural resources. The CAADP pillar one on Sustainable Land and Water Management appreciates that both land and water are important and limited agricultural

production resources. Therefore, to attain food security and sustainable development in Africa, this programme recognizes the need to conserve the natural environment, biodiversity, ecosystems and other natural resources, thus expressing its support for Eco-innovation.

The African Agenda 2063 is a fifty-year development plan for Africa that describes "the Africa We Want." It was adopted in 2015 as the basis for Africa's long term socio-economic and integrative transformation. This agenda is implemented in Ten Year Implementation Plans at the continental, regional and national levels. One of the set goals for this Agenda is to attain environmentally sustainable and climate-resilient communities and societies, which is achieved through sustainable natural resource management, biodiversity, ecosystem and genetic resource management, renewable energy and climate change resilience among others, thus implicitly articulating its support for Eco-innovation in the continent.

In the East African Region, ***the Treaty for the Establishment of the East African Community (EAC),*** signed in 1999 aims to widen and deepen economic, political, social and cultural integration to improve the quality of people's lives through increased competitiveness, value-added production and trade. Since the establishment of the EAC, agricultural development has taken the centre stage given that all the East African economies are agriculture-based. Its focus is on increasing agricultural production, food sufficiency in the community as well as enhancing post-harvest preservation and improved food processing. This treaty encourages the adoption of eco-friendly practices for the control of land degradation, minimization of Ozone layer depletion substances, afforestation, and soil and biodiversity conservation. It also promotes the production and use of biodegradable pesticides and herbicides as a way of protecting the environment, thus promoting Eco-innovation.

Eastern Africa Regional Bio-economy Strategy 2020-2030 (Draft) aims to use the abundant bio-resources in eastern Africa as a strategic base for sustainable economic growth and the development of effective and sustainable bio-economies. The central feature of the bio-economy strategy is to apply scientific research and knowledge to biological resources including agricultural and bio-production systems not only for the production of food, feed and fibre but also to an increasingly wide range of agro-industrial and value-added products with potential applications in many sectors such as pharmaceuticals, industry, chemicals, and energy. A large part of the economy and the export earnings in Eastern Africa is currently based on the export of raw materials, especially the export of unprocessed agricultural products which are facing an increased global competition (e.g., coffee, tea, etc.). The agro-processing sector in the region is also working in a non-optimal fashion, producing large amounts of underutilised bio-waste, often causing significant environmental problems. The production and extraction of bio-resources and trade of primary produce and the low degree of bioprocessing and value addition have made it difficult for the region to use its bio-resources as an engine for economic growth. The Regional Bio-economy Strategy, therefore, builds upon the foundation laid by science, technology and innovation (STI) policies developed by the countries in the region aimed at creating an enabling environment for increased STI investments supporting sustainable development and socio-economic transformation. The regional strategy and the subsequent national Bio-economy strategies will provide a framework to guide biosciences research and development (R&D) and innovation investments, as well as decision-making pathways as Eastern African countries move towards bio-based economies. These strategies will also create an enabling environment for a wide range of

role players including government line ministries and departments therein, industries, venture capitalists, academia, private sector entrepreneurs, and practitioners in the agricultural, health, energy and bio-based sector, and the broader public. The strategies will also identify areas where public policy can lower barriers, create incentives, encourage innovation and improve cooperation between and among stakeholders.

The Economic Community of West African States Agricultural Policy (ECOWAP) Strategic Policy Framework of 2015-2025 aims to address the key social, economic and environmental sustainability issues in the West African region. This strategic framework was adopted in 2015 after an ECOWAP review process. This policy framework focuses on key sustainability challenges in the region linked to food security, nutrition, climate change, youth employment in agriculture and gender among others. Considering the diverse nature of the West African farming systems, this policy focuses on modernizing the agriculture sector by making it competitive, inclusive and sustainable, guaranteeing decent jobs, food security and nutrition and food sovereignty. This policy framework is committed to strengthening the resilience of people's livelihoods and production systems to the impacts of climate change, through investing more in activities that increase resilience to climate variability as well as integrating risk management and resilience in policies and strategic plans. This gives a clear indication that this policy framework is supportive of green growth in the region.

The ECOWAS Policy on Science and Technology (ECOPOST) is the West African region's development blueprint up to 2020. It proposes a roadmap for improving governance, accelerating economic and monetary integration as well as fostering public-private partnerships. It provides a framework for the member states to improve their national policies and action plans for science, technology and innovation. It also advocates for the development of a science culture in all sectors of society, through science popularization, dissemination of research products both locally and internationally, commercialization of research results, technology transfer, and protection of intellectual property rights and enhancement of traditional knowledge among others. The policy proposes an increase in gross domestic expenditure on research and development (GERD) to 1% as proposed by the African Union, increase the generation and dissemination of new and clean technologies especially in areas of national interest, thus supporting Eco-innovation.

In the Southern African region, the ***SADC Policy Paper on Climate Change of 2012*** recognizes that the Southern African Development Community (SADC) region has various climate-sensitive sectors that are critical in the economic development and people's livelihoods in the region. This paper gives a detailed analysis of the causes of climate change in the area, stating that the level of greenhouse gas emission in the region is still low since it is usually associated with energy production and the level of economic development. This paper appreciates the need for the SADC member states to reduce the impacts of global warming and climate change through adopting various adaptation and mitigation measures such as increased access to cleaner and cheaper low-carbon renewable energy sources and investing more in human resource development as a way of increasing their ability to adapt to the changing climate[4]. It recognizes the vulnerability of the member states to climate change posing serious challenges on agriculture, water, energy, forestry, health, environment and other key sectors of the economy. This policy paper gives various

[4] https://www.sadc.int/themes/meteorology-climate/climate-change-adaptation/

strategic interventions such as rainwater harvesting and storage, diverting from rain-fed to irrigated agricultural production, diversification of agricultural production and establishment of micro-finance schemes for extreme weather events among others, aimed at reducing the impacts of climate change across sectors, which are inclusive and innovative, hence showing its support for green growth and its sustainability in the region.

3.1.4 Continental and Regional Eco-innovation relevant institutions and actors

Although the aspect of Eco-innovation has not been embraced fully across the African content as an explicit concept, several institutions can be identified as supporters and implementers of environmentally friendly innovations. Below are some organizations implementing or supporting Eco-innovation related initiatives in Africa (Table 1).

Table 1: Continental and Regional Bodies and their Roles in Eco-innovation

Name of institution/ actor	The role played in support of Eco-innovation
African Union (AU)	Mandated to commission and coordinate the implementation of eco-friendly policies, strategies and plans to ensure sustainable growth across the continent
East African Community (EAC)	Aims to attain sustainable development in the East African region through formulating, coordinating and facilitating the implementation of environmentally sensitive policies and strategic plans
Economic Community of West African States (ECOWAS)	Commissions and coordinates the formulation and implementation of policies and strategies that foster social and economic development in the West African region in an eco-friendly manner
African Union Development Agency - New Partnership for Africa's Development (AUDA-NEPAD)	Promotes sustainable environmental management through enhanced partnerships, coordination and harmonization of activities in Africa
Southern African Development Community (SADC)	Aims to alleviate poverty and attain sustainable growth and development within the member states through policies, conventions and development plans that conserve and protect the environment

3.2 Eco-innovation Related Policies and Institutions in Botswana

3.2.1 Overview

Botswana, one of Africa's most stable countries, is the continent's longest and continuous multi-party democracy nation. Sparsely populated, Botswana protects some of Africa's largest areas of wilderness. Safari-based tourism - tightly controlled and often upmarket - is an important source of income. Despite having one of the world's fastest-growing economies over the past 50 years, Botswana remains reliant on diamonds and the public sector, making it vulnerable to short term shocks and structural changes (Matambo, 2016). It is the world's largest producer of diamonds and the trade has transformed it into a middle-income nation. Although poverty has been declining rapidly, it remains high in rural areas, and low job creation means inequality levels are still some of the world's highest. Urban-rural gaps are significant in basic services, especially sanitation and electricity. Botswana Diamond mining fuelled much of Botswana's past economic expansion and

currently accounts for one-quarter of GDP, approximately 85% of export earnings, and about one-third of the government's revenues. In 2017, diamond exports increased to the highest levels since 2013 at about 22 million carats of output, driving Botswana's economic growth to about 4.5% and increasing foreign exchange reserves to about 45% of GDP5. Real GDP growth was an estimated 4.2% in 2018, up from 2.4% in 2017, boosted largely by the recovery in mining and broad-based expansion of non-mining activities.

Botswana's environment is fragile due to factors like climatic variability and human activities. The growing human and animal population, urbanization and industrialization are the major factors causing enormous pressure on the natural resources and other environmental hazards like pollution, water scarcity, desertification and extinction of wildlife species among others. All these impose serious economic, social and environmental challenges to the economy and its sustainability. As a result, various policies and strategic plans have been put in place to offer guidance and support on how to deal with such challenges. The Government of Botswana (GoB), as a Party to the UNFCCC, has, over the years, been actively involved in climate change vulnerability assessments, adaptation and mitigation efforts (GoB, 2019). Botswana ratified the Paris Agreement on climate change on 11 November 2016 and the SADC centre in Gaborone hosts the Regional Early Warning System, Famine Early Warning System and Climate Services Centre.

The Botswana Vision 2036 is a transformational agenda that describes the country's aspirations and goals, envisioned to achieve prosperity for all. The Vision aims to pursue a sustainable pathway, through balancing social, economic and environmental objectives. To ensure environmental sustainability, the Vision enhances sustainable and optimal use of the natural resources, thus attaining healthy ecosystems that support the economy and the people's livelihoods as well as enhance their resilience to climate change. Concerning the energy sector, the vision aims to transform it through increased exploitation of renewable energy with special emphasis on energy efficiency to meet the escalating demand. Under pillar 3- Sustainable Environment, it envisions that by 2036, sustainable and optimal use of our natural resources will have transformed the economy and uplifted our people's livelihoods by observing the ecosystem's carrying capacities, applying limits of acceptable changes and promoting maximum sustainable yield for renewable resources (GoB, 2016). Non-renewable resources mined in an environmentally friendly way, and the proceeds reinvested into man-made capital stock, human capacities and financial assets that can be productively harnessed for future generations. The country will account for the full economic value of its natural resources and ecosystems (GoB, 2016). It recognizes that investment, research and innovation is vital in the support and implementation of a transformative agenda towards a green and resilient economy. This is a clear indication that Vision 2036 supports Eco-innovation development in the country.

The Eleventh National Development Plan (NDP 11) of 2017-2023 aims to achieve inclusive growth for the realization of sustainable employment creation and poverty eradication. This is achieved through the development of diversified sources of economic growth and sustainable use of natural resources among others. In the energy sector, the plan focuses on developing cost-effective and environmentally sustainable sources of energy supply. This plan identifies renewable

[5] https://www.cia.gov/library/publications/the-world-factbook/geos/bc.html

energy as a significant contribution to address the country's energy security concerns as well as its climate change targets. In addition, it highlights solar energy as a promising off-grid solution, thus expressing its support for Eco-innovation. NDP 11 provides strategies in handling various issues affecting the country ranging from economic development, environmental issues, natural resources management, climate change as well as governance issues. These strategies are based on the experiences in implementing NDP 10. During NDP 11, programmes will be put in place to improve the status of the species (flora and fauna). Attempts will be made to: improve the legislative framework; develop appropriate standards; improve inventory; and intensify compliance efforts by monitoring the status and diversity of species within the predetermined localities (GoB, 2017). In order to attain a sustainable environment, public education and awareness will be intensified. According to the plan, more heritage sites will be developed and utilised to promote the tourism sector. Better management practices will also be explored to enable the communities to utilise the heritage sites sustainably. To achieve the goal of sustainable management of heritage sites, Government will intensify public education and awareness as well as stakeholder engagement. The management plans will be implemented to enhance the utilisation of the heritage sites while existing ones will be reviewed and updated, where necessary (GoB, 2017).

3.2.2 Enablers and/or constrainers of Eco-innovation in Botswana

Botswana like any other African country has a renewed commitment to environmental concerns, which gives a thrust to Eco-innovation. The rich natural resource base of the country and the need to conserve them to meet the demands of the growing population is a good reason for the country to divert to eco-friendly practices. Availability of ready and potential market for Eco-innovation products especially in South Africa is a big drive for the industry and manufacturing sector of Botswana to tap on. In addition to the rich natural endowment in Botswana, the government established and funded research institutions such as the Botswana International University of Science and Technology (BIUST), University of Botswana (UB), Botswana Institute for Technology Research and Innovation (BITRI) and Botswana Innovation Hub (BIH) to be the engines that drive the transition of Botswana's economy from being based on resources to a knowledge-based economy through the building and development of knowledge and innovation. Currently, research innovation and incubation park are being established at BIUST under its directorate of research, to incubate technologies derived through research carried out by researchers and innovators in the private sector or community. BIH provides incubation services for technology-driven businesses for them to be set up to penetrate their respective markets.

On the other hand, some factors limit the eco-innovative capacity of Botswana. Low level of education is identified as a key constraint since it limits the technological innovativeness of the labour force. The harsh climatic condition of the country is also a big challenge, especially to the agriculture and manufacturing sectors. This makes the country to rely on imports of primary goods from the region. The country does not provide any financial support or incentives to the local innovators such as tax relief or interest-free loans. Therefore, Botswana needs a national research agenda that could provide a clear and deliberate direction to the various stakeholders on priority areas which could guide on the technologies that may impact the lives of Batswana. In order to support Eco-innovation through modern technology, research work must be given priority on the national grid. This, therefore, calls for the establishment of a national research council, a body that is currently lacking in Botswana. This will help to streamline and financially support research activities in the country. Just like in any other country in the world, politics play a major role in

any development agenda. In Botswana, it influences decision making at ministerial levels. Long bureaucratic processes inhibit progress in policy implementation which is sometimes caused by the change in leadership in ministries. This results in to delay in the achievement of eco-innovative objectives and the overall goals.

3.2.3 Eco-innovation related Policies and Frameworks in the Environment and Natural Resources sector-Botswana

Botswana's natural environment is a bit volatile due to the harsh climatic and demographic factors such as unreliable rainfalls, frequent droughts and pressure from human activities, yielding environmental degradation, loss of biodiversity and pollution. According to Moleele and Ntsabane (2002), unsustainable development in most of the South African economies is driven by economic and sectoral policies that are narrowly conceived and focused, thus neglecting important aspects of the environment. Since the economic development of a country is based on its natural, human and social wealth, Botswana has realized the importance of making transformative policies and regulations that enable its sustainable development.

Sustainable use of natural resources has been a key component for much of Botswana's economic planning for development, which includes a series of ten (10) National Development Plans. Botswana has passed many national policies, such as the Wildlife Conservation Policy (1986), the National Policy on Natural Resources Conservation and Development (1990), the Wildlife Conservation and National Parks Act (1992), and the Environmental Impact Assessment Act (2005) which embed natural resources conservation and sustainable development into Botswana's national strategies and priorities. Botswana has also been successful in implementing the UNDP and UNEP's Poverty-Environment Initiative (PEI) which supports Botswana in mainstreaming environmentally sustainable natural resource management in the nation's poverty reduction strategies by implementing linked poverty-environment projects. In 2012, Botswana was one of ten African countries which adopted ***the Gaborone Declaration for Sustainability in Africa at the Summit for Sustainability***. The signatories of this declaration recognized that GDP has its limitations as a measure of well-being and sustainable growth. They vowed to integrate the value of natural capital into national accounting and corporate planning and reporting processes, policies and programmes.

The Community Based Natural Resource Management Policy of 2007 establishes a framework that incentivizes rural communities to engage in sustainable natural resource conservation. This is achieved by providing an opportunity for the community to participate in conserving and managing the natural environment and the natural resources, based on sound scientific principles and practices. The conservation agenda in this policy focuses mainly on wildlife which generates some benefits to the communities. Through this policy, the Botswana government realizes meaningful institutional devolution to the local levels where the wildlife is conserved, advocating for an equitable share of the accrued revenues and other benefits. This policy is eco-friendly in the sense that its main focus is on how the existing natural resources and environment can be protected while accruing returns to the locals equitably and sustainably.

The Forest Conservation Strategy of 2013-2020 aims to raise the visibility and profile of the forestry sector, conserve and better utilize the available forest resources for the benefit of the rural communities and sustainable development of the economy. The strategy seeks to promote the

implementation of activities that maintain, restore, protect and ensure sustainability in forest resource utilization. Among its strategic interventions, it promotes the sustainable management of biodiversity and forest resources, encourages participatory management of forest reserves and promotes sustainable multiple uses of the forest reserves, thus exhibiting its support for Eco-innovation.

The National Policy and Strategy for the Conservation and Management of Elephants of 2003 considers the elephant population in the country as an important natural resource of great economic potential. This policy recognizes the existing threats facing the existence of the elephants, hence the need to protect and conserve them. This policy promotes and facilitates sustainable utilization of wildlife resources, to conserve biodiversity for the benefits of both the present and future generations. It also ensures conservation and protection of the indigenous wildlife resources and their habitats, through minimal interference and where possible through adaptive management. The policy promotes continuous research in all areas of wildlife management, thus expressing its support for Eco-innovation.

The Botswana Biodiversity Strategy and Action Plan of 2007 is cognizant of the value of the country's biodiversity, ecosystems and species to the local communities and also the country's economic development, especially to the wildlife and tourism sub-sectors. The strategy envisions a nation where there is balance with nature and fair access to biological resources as well as equitable distribution of the benefits derived from the resources for both the current and future generations. This is achieved through a better understanding of biodiversity and ecological processes, long-term conservation and management of the country's biological and genetic resources, efficient and sustainable utilization of all components of biodiversity and establishing coping mechanisms for environmental changes and threats to biodiversity among others, thus supporting green growth in the country.

Botswana Climate Change Response Policy (BCCRP) draft of 2016 takes into account Botswana's specific ecological circumstance, vulnerability, needs and contribution to GHG emissions, prioritizes adaptation actions. The mitigation actions are undertaken within the framework of building national resilience with priority being given to those mitigation measures that have adaptation and development co-benefits. The climate change response mechanisms include, but are not limited to the ecosystem, market and community-based actions which involve actors and all sectors. The policy recognizes that the integrity of our biodiversity and ecosystems continue to contribute significantly to the country's GDP particularly from wildlife and tourism activities. Any increased pressure on the adaptive capacity of our ecosystems is likely to have significant negative impacts on our economy and human livelihoods. Therefore, it commits to promoting conservation and sustainable use of biodiversity and effective management of ecosystems, as well as the promotion of equitable sharing of benefits from natural resources in line with Eco-innovation.

Botswana National Climate Change Strategy and Action Plan (NCCSAP) of 2018 is being implemented through the Ministry of Environment, Wildlife and Tourism in cooperation with the UNDP. The objectives of the NCCSAP are (Nachmany et. al., 2015) to develop and implement appropriate adaptation strategies and actions that will lower the vulnerability of Botswana and various sectors of the economy to the impacts of climate change; develop action and strategies for

climate change mitigation; Integrate climate change effectively into policies, and institutional and development frameworks, in recognition of the cross-cutting nature of climate change; and ensure that Botswana is ready for the post-2015 climate regime when a new Protocol applicable to all parties will be finalised.

National Water Policy of 2012- The National Water Master Plan Review in 2006 recommended that a series of institutional reforms were required within the water sector. These are needed to meet the increasingly complex challenges facing Botswana in the development of water resources, the supply of water and overall management of the sector. Recognizing that water represents one of the key constraints to future sustained growth, the National Water Policy provides the guiding principles and policy direction for the development of National Development Plans. Economic growth in Botswana has been driven primarily by the nation's natural resources: mining, nature-based tourism, and agriculture. The development of these resources has been supported by sound macroeconomic policies, strong financial management and the implementation of incentives to attract private enterprise against a background of political stability. Recognizing the importance of the environment to securing this sustainable growth, this has been accomplished with relatively little environmental degradation or loss of biodiversity. The Objective of the National Water Policy is, therefore, to provide a national framework that will facilitate access to water of suitable quality and standards for the citizenry and provide the foundations for sustainable development of water resources in support of economic growth, diversification and poverty eradication. The policy promotes the following: Protection, conservation and restoration of the nation's water resources; Promotion of effective, sustainable management of water resources; Promotion of the equitable and efficient use of water resources; Reduction of the subsidies associated with water supply; Assurance of access and affordability of water for all; Protection and restoration of the environment; and promotion of productive uses of water. All these are in line with Eco-innovation principles.

Table 2 provides the key stakeholders in the Environment sector in Botswana that are critical in promoting Eco-innovation in the country. Their roles have also been provided.

Table 2: Eco-innovation relevant Institutions and actors in the Environment sector- Botswana

Name of institution/ actor	The role played in support of Eco-innovation
Ministry of Environment, Tourism and Wildlife	Plays the regulatory mandate for environmental protection and management.
Ministry of Minerals, Energy and Water Resources	Responsible for providing strategic direction to the minerals, water resources and the energy sector
Department of Environmental Affairs	Develops environmental impact assessment guidelines that define the standards upon which environmental projects are evaluated.
Department of Waste Management and Pollution Control	Facilitates waste management and recycling system, imposing fines on polluters and implementing environmentally friendly waste management programmes.
Department of Meteorological Services	Provides quality meteorological information to different sectors of the economy for the protection of life and other resources and ensure sustainable development.

Department of Wildlife and National parks	Mandated to conserve and protect wildlife resources, including vegetation throughout the country and in protected areas.
National Climate Change Unit	Responsible for implementation, monitoring and compliance with climate change response measures as defined by the policy.
National Climate Change Committee	The committee advises on matters relating to national responsibilities with respect to climate change and international obligations and implementation of response measures.
District Climate Change Committees	The committee will be responsible for integrating climate change into district development plans and assist in building climate-resilient development planning at local levels.

3.2.4 Eco-innovation related Policies and Frameworks in the Energy sector- Botswana

Botswana is an energy-rich country with both renewable and non-renewable sources of energy. The energy sector is one of the main sectors that are said to contribute to greenhouse gas emission through energy production, conversion and use. Botswana relies mainly on electricity, coal, fuelwood and petroleum for its energy demands Botswana currently generates most of its power from coal and sits on large coal reserves of around 200 billion tons. The country also has significant solar potential, with 3,200 hours of sunshine per year, and irradiance of 6640 Wh/m2/day (GoB, 2019). Only a portion (450 MW) of installed capacity is available to produce power, and additional demand is met through electricity imports, primarily from South Africa. The government has set a national electricity access target of 82% by 2016 and 100% by 2030. Currently, electrification in urban areas stands at 75 % and 57% in rural areas while the national average electrification is 62% (GoB, 2019). Liquid Petroleum Gas (LPG) is widely used as the main energy source for cooking in urban areas by 70.7% of the households and 40.5% in rural areas (GoB, 2019). LPG is supplied by the private sector with minimum interference from the government.

The draft National Energy Policy of 2015 provides a framework to guide the effectiveness and sustainability in energy planning, development and provision. It also appreciates the significance of various sources of renewable energy in the economy. The policy gives a detailed strategy for the development of renewable energy, emphasizing on the low cost and high benefits associated and in particular focusing on solar energy, thus making it competitive with other non-renewable energy sources. The policy gives a cross-sectoral view of the energy efficiency in the country. Therefore, this implies that policy supports Eco-innovation in the country's energy sector.

The Botswana Energy Master Plan of 1996, reviewed in 2003 aims at improving the people's livelihoods through easing their access to modern and affordable energy service across the country. This is achieved through promoting the integration of grid and non-grid technologies, encouraging research and development of renewable energy sources, promotion of solar energy by the government, identification of appropriate institutional framework for rural electrification using renewable energy, and development of strategies for the removal of barriers of widespread use of renewable energy, thereby supporting Eco-innovation. One example of a renewable energy project implemented in Botswana is provided in Box 1 below.

Box 1: The biodiesel production project in Botswana

The biodiesel production project at the University of Botswana, as well as clean coal and waste to energy research projects conducted at the Botswana International University of Science and Technology (BIUST). The University of Botswana Biodiesel Research Unit in the Faculty of Engineering and Technology (FET) has commissioned a biodiesel processing unit. Designed to produce 380 litres of biodiesel per batch from different feedstock sources, it was commissioned by Mmetla Masire, Permanent Secretary in the Ministry of Mineral Resources, Green Technology and Energy Security, at Block 251 on February 11, 2020. According to Secretary Masire, biofuels had become an attractive source of energy since they offered the prospect of domestic energy generation and a reliable, renewable source of fuel. Furthermore, biofuels had the potential to reduce greenhouse gas (GHG) emissions, as well as to facilitate the establishment of new industries, employment prospects, and incomes. https://bioenergyinternational.com/biofuels-oils/university-botswana-commissions-biodiesel-production-unit

The Botswana Biomass Energy Strategy of 2009 ensures biomass energy is produced, supplied and used in a socially, economically and environmentally sustainable manner. Special attention was given to gender issues, improving the welfare of the poor and contributing to the sustainable socio-economic development of the country in general. To ensure environmental protection and conservation, the strategy analyses the potential impact of all biomass technologies adopted with respect to greenhouse gas emission, air, water and soil pollution, and biodiversity management, thus a clear indication of its support for Eco-innovation.

Table 3 provides the key stakeholders in the Energy sector in Botswana that are critical in promoting Eco-innovation in the country. Their roles have also been provided.

Table 3: Eco-innovation relevant Institutions and actors in the Energy sector- Botswana

Name of institution/actor	The role played in support of Eco-innovation
Ministry of Minerals, Energy and Water Resources	Responsible for providing strategic direction to the minerals, water resources and the energy sector
National Committee on Climate Change	Planning and coordination of all activities related to climate change, communication with stakeholders and raising of awareness.
Botswana Power Corporation	Responsible for electric power generation and supply ensuring minimal greenhouse gas emission
The Department of Energy	Is mandated to establish the policy, legal and regulatory framework of the energy supply and demand in the country
Botswana Energy Regulatory Authority	Mandated to oversee the economic sustainability of energy supply, setting tariff regulations and overseeing the efficiency of energy supply.
Botswana Renewable Energy Agency	Promotes and coordinates the uptake of renewable energy in the country.
Botswana Power Corporation Lesedi (Pty)	Mandated to develop renewable energy generation and specifically renewable energy electrification.

3.2.5 Eco-innovation related Policies and Frameworks in the Agriculture sector- Botswana

Botswana's agricultural sector covers both crop and livestock production with traditional subsistence farming dominating. With the current environmental and climatic changes, crop production is the hardest hit leading to reductions in production volumes and efficiency. The agriculture sector is laden with opportunities for meeting the green economy targets although its growth rate has been minimal. These opportunities lie within conservation agriculture, organic agriculture, expansion of irrigation systems and participatory integrated land use and management planning.

The National Policy on Agricultural development of 2014 aims to achieve food security in the country as well as diversify the agriculture sector. This is attained by adopting new and improved crop and livestock production technologies that promote output and productivity growth. As a way of increasing the economic gains from agriculture, the policy makes strategic interventions to promote domestic and regional marketing of agricultural products. Moreover, it recognizes the importance of incorporating and mainstreaming disadvantaged groups in agricultural programmes. This policy is supportive of Eco-innovation development within the sector through the promotion of environmentally sustainable production systems and climate-smart agriculture. ***Conservation of Agricultural Resources Programme*** under the NDP11 seeks to put mechanisms in place to harness indigenous knowledge and utilise local resources to efficiently and effectively manage and conserve agricultural resources. This will be attained through the involvement of local farming communities. Efforts will be undertaken in conjunction with the local communities, to rehabilitate degraded agricultural lands to increase agricultural production, thereby attaining food security.

The National Strategy for Poverty Reduction of 2003 appreciates the fact that high poverty levels in the country, especially in rural areas, remain a big challenge to sustainable economic development. The strategy recognizes that drought is the major cause of poverty, especially within farming communities since it increases the risk of investing in agriculture. This strategy identifies programmes that can enhance the income-generating opportunities for the poor such as the development of the small-scale horticulture sub-sector, expanding opportunities for rain-fed agriculture through new technologies and strengthening community-based natural resource management. Although the strategy does not explicitly support Eco-innovation, some of its strategic interventions and recommendations are environmentally sustainable and aim to increase the efficiency of natural resource utilization.

The National Master Plan for Arable Agriculture and Dairy Development of 2002 aims to improve dry-land arable agriculture, promote crop irrigation and dairy farming through the development of large-scale mechanized dry-land farming, as well as promoting irrigation farming where feasible. The plan also recognizes the importance of developing infrastructure in the production areas, including tarred and gravel roads, provision of power lines, telecommunications and sources of potable water for irrigation. Although this strategy is not pro-Eco-innovation per se, it supports climate-smart agricultural production systems that are eco-friendly, sustainable and efficient. Table 4 provides the key stakeholders in the Agriculture sector in Botswana that are critical in promoting Eco-innovation in the country. Their roles have also been provided.

Table 4: Eco-innovation relevant Institutions and actors in the Agriculture sector- Botswana

Name of institution/ actor	The role played in support of Eco-innovation
Ministry of Agriculture	Mandated to make and implement policies that guide the entire sector.
Department of Agricultural Research	Responsible for conducting agricultural research on improved and environmentally friendly technologies for both crops and livestock.
The National Early Warning System	Monitors the status of national food security, provides information on the incidence, nature and cause of food insecurity including environmental issues.
Botswana Agricultural Marketing Board	Purchases agricultural produce from the farmers. Also provides improved production inputs to the farmers.

3.2.6 Eco-innovation related Policies and Frameworks in the Trade and Industry sector- Botswana

The economy of Botswana has gone through various trade regimes are which are influenced by the domestic and regional policy environment and trade agreements. The government has invested heavily in the industry sector making it competitive within the South African bloc. However, the major concern, in this case, is whether the industry will continue to flourish after the government support fades away. To ensure continued growth and sustainability of the sector, different policies have been made to guide the process.

The National Trade Policy of 2009 provides for the development of industries that offer the best export environment, especially to the private sector. This policy aims to achieve the broadest possible free and reliable access to markets for the country's exports and also enable producers and consumers to have access to the widest choices of goods and services on the best possible terms. In line with the international trade best practices, this policy focuses on developing and maintaining effective international trade policy documents, norms and standards consistent with the changing global demands. Besides, this policy forms an integral part of the country's vision of having a prosperous, productive and innovative nation. Although this policy does not explicitly support Eco-innovation, its consideration for both domestic and international trade standards is a push for market-driven Eco-innovation.

The National Export Strategy of 2006 intended to make Botswana's exports to be internationally competitive, thus assisting the country to attain industrial development and economic diversification. It envisions a country classified as a developed economy based on its sustainable, diversified and competitive export base. To achieve its goals, the strategy focuses on the improvement of competitive issues such as trade facilitation, capacity building and strengthening the country's trade networks. The strategy recommends that all export promotion programmes in the country should ensure that the environment is well protected since it offers the resources needed in trade, thus expressing its support for Eco-innovation.

The Industrial Development Policy of 2014 promotes the development of diversified and viable industries and commercial sectors in the country. This is attained through the use of skilled personnel and the use of appropriate technologies among others. This policy recognizes the need to adapt some aspects of other policy documents such as the National Trade Policy of 2009 to cope

with the changing industrial environment. Additionally, the policy unveils the importance of investing in creativity and deftness which are the major drivers of domestic and regional competitiveness, thus supporting Eco-innovation.

Table 5 provides the key stakeholders in the Trade and Industry sector in Botswana that are critical in promoting Eco-innovation their roles.

Table 5: Eco-innovation relevant Institutions and actors in the Trade and Industry sector- Botswana

Name of institution/ actor	The role played in support of Eco-innovation
Ministry of Trade and Industry	Coordinates activities of other ministries, departments and agencies that handle trade policy matters and admit trade agreements.
Botswana Export Development Investment Authority	Mandated to conduct export promotion activities in an environmentally friendly manner.
National Committee on Trade Policy Negotiations	It's the main consultative forum for the development and execution of trade policy negotiations. It is composed of divergent expertise with the environmental one ensuring all activities undertaken are environmentally friendly.
Botswana Investment and Trade Centre	Promotes sustainable exportation of local products, local investment and sustainable job creation.
Botswana Exporters and Manufacturers Association	Improves the competitiveness of the trade and export sectors through policy advocacy, creation of market awareness and facilitating the creation of sustainable employment opportunities.
Botswana Meat Commission	Promotes meat exports by reinforcing domestic and international meat quality standards in an eco-friendly way.
Botswana Technology Centre	Aligns research, science and technology with the country's development goals to ensure technology and innovation-led sustainable development.

3.2.7 Eco-innovation related Policies and Frameworks in the Science, Technology and Innovation (STI) sector- Botswana

Botswana is one of only four of the Southern African Development Community (SADC) countries that had ratified the SADC Protocol on Science, Technology and Innovation (2008) by 2015. It was also one of the first countries of SADC countries to adopt a science and technology policy in 1998. This was later updated in 2011 (Mbula-Kraemer and Mario, 2015). The significance of STI in Botswana social transformation and economic development cannot be overlooked. In this country, STI provides a reliable means of translating the existing natural resources into value-added quality goods and services towards the attainment of the country's development goals. Moreover, STI is very crucial to the socio-economic development of the country since it is anchored on the effective use of technology. As commonly understood, countries that invest more energy, initiative and money in technology reap the benefits of greater social and economic development, resulting in improved standards of living for the citizens. Echoing the past administrations of Botswana, the country cannot survive the ruthless global competition without harnessing the potential benefits of investing in STI.

The Research, Science and Technology Innovation Policy of 2011 was enacted to spur national investment in research and development in the ICT sector. The major role is to monitor the implementation of funded research projects, develop and implement strategies and mechanisms for technology diffusion, uptake and transfer. It also provides for a comprehensive data and information management system to inform decision making is critical. However, this policy is under review to improve the intended services to the people. It is silent on environmental sustainability or Eco-innovation.

The Botswana National Research, Science and Technology Plan of 2005 identify the country's priority investment areas in research. It represents an implementation framework for the National Development Plans as envisaged in the Botswana Vision 2016. The plan responds to the country's socio-economic challenges, including economic diversification, poverty, unemployment, HIV/AIDS and sustainable use of natural resources feasibly and cost-effectively. Among its strategic interventions is the establishment of mission-focused programmes that offer support for long-term and multi-disciplinary research in the areas of ecosystems, mining and processing and biosciences among others. The plan is cognizant of the importance of ensuring environmental sustainability through new and eco-friendly research and innovations, thus expressing its solid support for Eco-innovation in the country.

The National ICT Policy of 2004 aims to make Botswana a globally competitive, knowledge and information-based economy, where sustainable development is achieved in the social, economic and cultural fronts through effective use of ICT. This goal is achieved through cultivating a culture of lifelong learning that maximize the potential of all people to enhance their innovativeness hence building a knowledge-based economy and promoting electronic access to major government services. The policy also recommends the introduction of eco-friendly service delivery systems like e-health hence showing its support for the development of a green economy.

Box 2: Botswana Innovation Hub

Botswana Innovation Hub is an ideal location for technology-driven and knowledge-intensive businesses to establish themselves, develop and compete in the regional and global markets. New thinking and new opportunities are promoted at the Botswana Innovation Hub (BIH) in Gaborone, with emphasis on the development of sustainable companies with a particular focus on energy and the environment and clean-tech solutions. The BIH was established by GoB Strategy, which sought to deliver diversification, to move the country away from dependency on diamond mining. The country has been subject to the consequences of price fluctuations and the nuances of market dynamics with respect to diamonds and so has created a hub to promote science and technology. This is defining the future of innovation in Botswana. The hub is a Science and Technology Park comprised of some of the world's leading technology-driven and knowledge-based companies.
https://bioenergyinternational.com/biofuels-oils/university-botswana-commissions-biodiesel-production-unit

The Strategy for Economic Diversification and Sustainable Growth of 2008 focussed on addressing the primary challenge facing the economy, which is diversification to ensure that the citizens continue to enjoy the benefits of sustained economic growth, especially in the minerals sub-sector. The strategy recognized the need for the government to capitalize on the abundant financial, human and natural resources to achieve the diversification objective. Additionally, it gives a multi-sectoral approach to driving the economy's diversification objective. In the STI sector, it proposes the establishment of Botswana Innovation Hub, which is intended to foster the development of a high technology sector (Box 2). This will provide the infrastructure, space and incentives for companies in the IT, communication and biotechnology fields. This strategy supports green growth in the country since it appreciates the importance of investing in sustainable and eco-friendly technologies and innovations that drive the economy's diversification agenda.

Table 6 provides the key stakeholders in the STI sector in Botswana that are critical in promoting Eco-innovation and their roles whereas Figure 2 shows their roles in the National Innovation System.

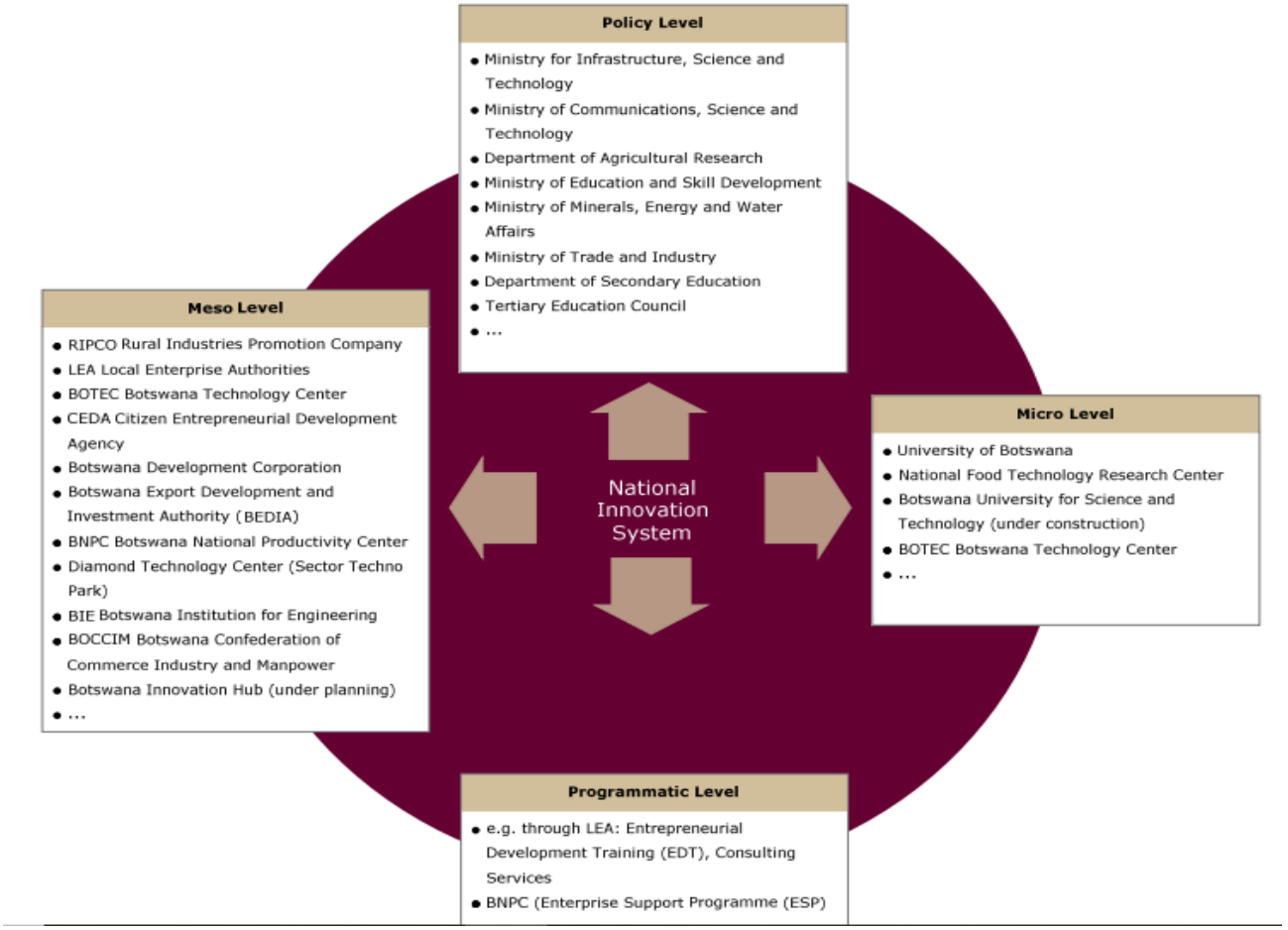


Figure 2: The main players in the Botswana innovation system

Table 6: Eco-innovation relevant Institutions and actors in the Science, Technology and Innovation (STI) sector- Botswana

Name of institution/actor	The role played in support of Eco-innovation
Ministry of Communication, Science and Technology	Responsible for formulating and coordinating the implementation of STI policies through collaborative efforts to harness the local resources, talents and innovations.
Department of Research, Science and Technology (DRST)	Mandated to define the research projects funded by the government and the reason for funding
Botswana Technology Centre (BTC)	Conducts research, development and technology transfer especially on renewable energy, sustainable architecture, wastewater management and ICT systems.
Botswana Research, Science and Technology Agency	Responsible to facilitate and coordinate research activities outlined in the mission-focused programmes, most of which are eco-friendly.
Rural Industries Promotion Company	Undertakes research and development to support industrial, entrepreneurial and socio-economic development

3.2.8 Eco-innovation related Policies and Frameworks in the Transport sector- Botswana

The transport sector plays a crucial role in the growth of the Botswana economy. The sector receives a substantial share of the government resources which is a reflection of its significance in the economy. In the last two decades, the nation has achieved a major milestone in developing the major transport infrastructure especially for opening up and linking the mines with the markets. Since the country's development is market-oriented, the government is keen to formulate policies and regulations that help the growth of the transport sector and therefore reduce resource wastage from free-market competition.

The National Integrated Transport Policy of 2011 establishes the long-term framework for the management and development of the country's transport sector. This policy outlines crucial changes that are to be made within a twenty-five-year period. This policy recognizes the need to care about future generations by laying down some guidelines for greening the transport sector. It appreciates that heavy vehicles cause considerable damage to the roads and streets, causing noise, dust and air pollution, which is against the government's focus to improve the quality and safety of the people. To achieve the greening objective, the policy aims to reduce greenhouse gas emissions through promoting rail transport for long-distance travels which is environmentally friendly compared with freight. It also aims to raise the standards of vehicle testing including emissions standards, thus expressing its support for green growth in the transport sector.

The key stakeholders and their role in the Transport sector in Botswana that are critical in promoting Eco-innovation have been provided in Table 7.

Table 7: Eco-innovation relevant Institutions and Actors in the Transport sector- Botswana

Name of Institution/ Actor	The role played in support of Eco-innovation
Ministry of Transport and Communications	Mandated to provide safe, secure, reliable, affordable and sustainable transport and communication services while protecting the environment.

Department of Road Transport and Safety	Conducts vehicle registration, licensing and examination, driver training and examination, issuing transport permits and public transport inspection and enforcement of standards, including the emission standards.
Department of Information Technology	Mandated to facilitate and administer ICT information across the sector in an eco-friendly way.
Central Transport Organization	Ensures efficient use and management of fuel in government vehicles.

3.2.9 What works, what doesn't work and why in Botswana

Botswana has established various policies and institutions that have put in place a good foundation for research and innovation cutting across the various sectors studied. The policies that have been put in place in the different sectors support Eco-innovation in different ways as highlighted in the previous sections. The following subsections describe successful and unsuccessful initiatives resulting from the policies and institutions in terms of what works, what doesn't work and why.

3.2.9.1 What works and why

a) Poverty-Environment Initiative (PEI)

Supporting Policies and Strategies: Botswana Vision 2036, the Eleventh National Development Plan (NDP 11) of 2017-2023, the Community Based Natural Resource Management Policy of 2007, the Forest Conservation Strategy of 2013-2020, the Wildlife Conservation Policy of 1986, the National Forest Policy & the Tropical Forest Conservation Fund Order, the NDP11, and the SADC Renewable Energy and Energy Efficiency Strategic Action Plan (REEESAP) 2016-2030.

Description and impact: The Poverty-Environment Initiative (PEI) is a programme aimed at strengthening the capacity of Governments to integrate environmental sustainability as a core objective in development planning and implementation. PEI builds on the success of a similar partnership that leveraged the comparative advantages of the UN Agencies. The PEI has pioneered integrated approaches to mainstreaming poverty-environment linkages in national development planning and implementation processes—first in support of national efforts to achieve the Millenium Development Goals and now as a model for implementation of the 2030 Agenda and the SDGs. By building on PEI's legacy, Poverty-Environment Action was uniquely placed to ensure that the environmental dimension is not left behind when addressing poverty. Poverty-Environment Action provided opportunities to improve the quality of private sector investments to support poverty-environment objectives. As a result of the project, Botswana Government took community-based natural resource management as a core approach to local tourism development and management of wildlife. The potential of community-based natural resource management features prominently in the Botswana Government's approach to local tourism development and the management of wildlife resources at the community level, building on the country's successful integration of poverty-environment issues during the review and drafting of the Tourism Policy and Wildlife Conservation Policy.

Reasons for success:

- Multi-international Agency support.
- Significant government buy-in and support.

- Regional support and collaboration with other countries.
- Government commitment to poverty eradication and environmental protection as defined in the various development plans and policies.

b) Establishment of Botswana Innovation Hub (BIH)

Supporting policies and Strategies: The Strategy for Economic Diversification and Sustainable Growth of 2008, the National Policy on Research, Science, Technology and Innovation of 2011, Botswana Excellence Strategy of 2008, Vision 2016 and Vision 2036.

Description and impact: The Botswana Innovation Hub (BIH) was established pursuant to an Act of Parliament as a science and technology park to inter-alia foster Botswana's transition to a knowledge-based economy that actively responds to the needs of the people of the Republic of Botswana. The Botswana Excellence Strategy of 2008 envisages a transformation of Botswana into a technology-driven and knowledge-based economy through the promotion of a culture of innovation and competitiveness. The GoB envisages a stronger role of STI in the national economy going forward. For Botswana to transform into a knowledge-based economy, one of the critical ingredients is ensuring the development of people's capacity to innovate. Furthermore, there must be deliberate efforts placed on establishing mechanisms to support the commercialisation of home-grown innovations into tangible products and services. To this end, BIH is focusing on enhancing innovation drivers including promoting Science, Technology, Engineering and Mathematics (STEM) related programmes and activities, supporting technology entrepreneurship, providing innovation funding and management as well as Intellectual Property registration. The successful implementation of the above will ensure the attainment of the much-needed national economic diversification.

The BIH also promotes the use of clean technologies to reduce energy consumption and to introduce technologies to more individuals and communities across all age ranges- through ventures such as Biodiesel Botswana. Cleantech Centre allied to the BIH draws from a mixture of private and public funding and objectives aiming to maximise usage of renewable sources of energy such as solar power and to improve management of water resources, provision and utilisation. Energy efficiency also applies in the Cleantech Centre's attempts to reduce pollution produced by power generation from coal. Some of the major projects and achievements include;

- Successfully rolling out the Botswana Innovation Fund. The fund is a necessary catalyst to transform ideas into tangible products and solutions. The innovation fund is also envisaged to assist in growing the national intellectual property rights asset base and in the process improve Botswana's global competitiveness. For example, the mining company De Beers Group and Stanford Graduate School of Business (GSB) have teamed up to provide US$ 3 million, three-year partnership to empower young entrepreneurs and established business owners.
- Successfully partnering with a private company under a PPP initiative to develop a data centre project[6]. The primary objective of the project is to accelerate the digital transformation of Botswana through the provision of robust infrastructure to house local digital data in a secure and highly reliable environment whilst making it available for innovators to develop digital solutions that help Batswana.

[6] https://www.bih.co.bw/wp-content/uploads/2019/09/BIH-Annual-Report-2018.pdf

- As regards clean technologies, BIH partnered with a local private company to develop a solar-powered water treatment plant in Sojwe village. The objective of the plant was to treat borehole water by removing nitrates from the water to make it portable and safe to be used by the village. The prototype for the water project is at the commissioning stage.
- BIH has initiated the development of a solar testing and demonstration facility at the BIH Science and Technology Park. The objective of the project is to enable entrepreneurs and industry players to test and demonstrate solar products whilst at the same time powering the entire BIH Park.
- BIH has developed national and international partnerships that have yielded many important collaborations. One example of such partnership led to securing additional funding of EUR 1,200,000 (BWP 12,000,000) through partnering with the Southern Africa Innovation Support Program (SAIS).

The National Policy on Research Science Technology and Innovation (2011) policy objective 4.4.5 (RSTI 2011) is bold on importance of collaborations; "…*to promote the establishment of collaborations, partnerships and linkages among stakeholders, private sector and international science, research and development community*" As a consequence the establishment of institutions such as: Hubs (Innovation Hub and Diamond Hub), Centers of Specialization (National Food Technology Research Centre-The National Food Technology Research Centre (NFTRC) in collaboration with the Council for Scientific and Industrial Research in South Africa have collaborated on a project to come up with indigenous food development technologies out of native plants to Botswana, Botswana Vaccine Institute, Agricultural Research, Botswana Institute for Technology Research and Innovation), Specialized Universities (Botswana International University of Science and Technology, and Botswana University of Agriculture and Natural Resources) lead in the pursuit to diversify economy through research and development that leads to increased diversification.

Reasons for success:

- A conducive enabling policy environment
- Improved research infrastructure and facilities
- National support, partnership with Private sector and Regional Support

c) Functional National Innovation System

Supporting policies and strategies: Vision 2036, the National Policy on Research Science Technology and Innovation of 2011, the National ICT policy of 2004 and the Strategy for Economic Diversification and Sustainable Growth of 2008.

Description and impact: Ministry of Investment, Trade & Industry has institutions under it that provide funding for innovations, such as the Citizen Entrepreneurial Development Agency (CEDA) which funds projects by tertiary students. The Local Enterprise Authority incubates startups that are involved in innovation like hydroponic farming. The establishment of Companies and Intellectual Property Authority (CIPA) and its designated autonomy; establishment of the collection management society of Botswana (COSBOTS); concerted efforts evident between the Department of Research, Science and Technology (DRST) and CIPA on awareness building in IP; establishment of a national technology transfer office, BITRI, UB; and establishment of an innovation hub. the National ICT policy of 2004 and the Strategy for Economic Diversification

and Sustainable Growth of 2008 have strengthened innovation capacity by establishing systems and institutions that enhance innovation. The Department of Environmental Affairs under the Ministry of Environment, Natural Resources, Conservation and Tourism has the National Environmental fund that supports eco-friendly and innovative business ideas. The CIPA provides capacity building in terms of intellectual property protection mechanisms. The Botswana Bureau of Standards works with research institutions and companies in ensuring that their products are up to regional or international standards. Forest Conservation Botswana promotes activities designed to conserve, maintain, protect and restore the forests of Botswana. The NIS has been providing thematic direction, policy awareness, relevance and implementation of issues that are considered serious and urgent.

Reasons for success:

- Clearly defined roles of each of the actors in the NIS.
- Significant government support both financially as well as political support
- Establishment of Botswana Institute of Science Technology and Innovation
- Botswana has an Industrial Property Act enacted in 2010 and the Copyright and Neighbouring Rights Act. It provides for 'the protection of new, industrially applicable solutions to problems in any field of technology that involve inventive steps' and 'the protection of utility models, industrial designs, layout circuits of integrated circuits, traditional knowledge and handicrafts'. Copyrights and Neighbouring Rights Act copyrights and other related aspects to literary and artistic expressions.
- Botswana is also a signatory to other regional and international IP frameworks. These include TRIPS, the Patent Cooperation Treaty, the World Intellectual Property Organization, the Paris Convention for the Protection of Industrial Property, Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks and the African Regional Industrial Property Organization (ARIPO) and its protocols (the Harare Protocol on Patents and Industrial Designs, Banjul Protocol on Marks and Swakopmund Protocol on the Protection of Traditional Knowledge and Expressions of Folklore).

d) The Southern Africa Biodiversity Support Programme (SABSP)

Supporting policies and Strategies: Vision 2016-Vision 2036, SADC Regional Biodiversity Strategy of 2008 and Convention on International Trade in Endangered Species (CITES) of 1983.

Description and impact: The Southern Africa Biodiversity Support Programme (SABSP) is a regional biodiversity conservation and sustainable use initiative that started in 1996. The programme is supported by the Global Environment Facility with 10 participating countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. The target beneficiaries of the programme are the people, governments, NGOs, CBOs and industries of the countries participating in the collaborative programme. The overall goal of the SABSP is to improve cooperation, to build capacity both within and among participating nations and to integrate sustainable use into biodiversity conservation and other sectoral programmes. The programme led to the development of the Regional biodiversity information system; Regional expert network in various sectors; Regional biodiversity strategy, action plan and monitoring system development and incorporation in national and regional policies and plans on agreed implementation process; prioritized regional training needs in biodiversity

conservation and management and appropriate training courses developed and implemented; Pilot schemes and studies in biodiversity conservation and use; and additional funding for potential follow up biodiversity conservation activities to ensure the sustainability of the framework.

Reasons for success:

- Multi-international agency support
- Presence of a strong policy and institutional framework for biodiversity conservation.
- Significant government and regional support under SADC.

e) The Biodiesel Production Project at the UB and BIUST

Supporting policies and strategies: The Botswana Biomass Energy Strategy of 2009, Botswana Energy Master Plan, 2003, SADC Energy Protocol (1996), SADC Industrialization Strategy and Roadmap (2015) and Energy Sector Plan (2012).

Description and impact: Biofuels have become an attractive source of energy since they offer the prospect of domestic energy generation and a reliable, renewable source of fuel. Furthermore, biofuels have the potential to reduce GHGs emissions, as well as to facilitate the establishment of new industries, employment prospects and incomes. The biodiesel production project at the University of Botswana and the clean coal and waste to energy research projects were conducted at BIUST to feed the increasing energy demand. The University of Botswana Biodiesel Research Unit in the Faculty of Engineering and Technology (FET) commissioned a biodiesel processing unit that was designed to produce 380 litres of biodiesel per batch from different feedstock sources. This was commissioned by Mmetla Masire, Permanent Secretary in the Ministry of Mineral Resources, Green Technology and Energy Security in 2020. This was a major milestone achieved by research initiatives from the universities.

Reasons for success:

- Strong government support and commitment
- Private sector involvement and close collaboration with beneficiary communities

f) The Rural Electrification Programme

Supporting policies and strategies: The Botswana Biomass Energy Strategy of 2009 and Botswana Energy Master Plan, 2003: SADC Energy Protocol (1996); Revised RISDP (2015-2020); SADC Industrialization Strategy and Roadmap (2015); Regional Infrastructure Development Master Plan: Energy Sector Plan (2012); and Citizen Economic Empowerment (CEE) of 2012.

Description and impact: This programme was implemented fully by citizen consultants and contractors in accordance with the Citizen Economic Empowerment (CEE) of 2012 and Economic Diversification Drive (EDD) policies. The project was highly relevant in the context of rising fuel prices, the high cost of grid connectivity in rural areas, need to decrease the dependence on imported electricity and fossil fuels. It was also important in the efforts to reduce the country's emissions of GHG, including a reduction in the use of non-renewable biomass. The project was based on an integrated approach to address solar energy barriers (policies, financial engineering, hardware demonstration, awareness, and public-private partnership). The project led to increased use of solar energy through the provision of solar home systems for cooking and lighting

in rural villages in Botswana and the development of a mobile mini-grid in the village of Sekhutlane in southern Botswana. There was an increased investment by private companies such as Biowatt Botswana which offers clean and sustainable solutions in the form of renewable energy directly to the community. They conduct relevant research intending to take the solution to the people to ensure that Batswana and people in the Southern African region can continue to meet their energy needs without causing harm to the environment.

Reasons for success:

- Partnership with community cooperatives in rural areas
- Increasing private sector involvement and working PPP initiatives and close collaboration with beneficiary communities
- Increasing demand for clean energy sources
- Strong government support and commitment

3.2.9.2 What doesn't work and why

a) The Botswana Joint Committee

Supporting policies and strategies: The National Policy on Research Science Technology and Innovation of 2011.

Description and impact*:* The DRST attempted to establish the Botswana Joint Committee which is a structure made up of representatives from the different organizations, institutions and stakeholders in the different sectors to bring key players together to exchange knowledge in their various projects and foster collaboration and partnerships between entities. This structure left out representatives from the civil societies and private sector. The establishment of the Joint committee was informed by duplication of efforts by institutions such as the BIH and BITRI which work separately instead of partnering to prevent the government from investing in two different organizations. The Committee has therefore failed to bring together the different actors as envisaged. The establishment of a Science Granting Council (SGC) would help foster this collaboration. This role has now been left for DRST in the Ministry to play a facilitative role towards the SGC. The envisaged Botswana National Research, Development and Innovation Coordinating Council which shall be semi-autonomous is meant '*to advise the country's leadership and coordinate decision-making related to research, science, technology, and innovation*' has not been established yet hence derailing the whole process.

Reasons for Failure:

- Low participation by the private sector
- Lack of proper monitoring and evaluation system.
- Minimal or insignificant participation of CSOs and the private sector

Other factors that have contributed to the unsuccessful implementation of Eco-innovation related projects and initiatives in Botswana include:

- *Exclusion of the private sector*-The private sector plays a significant role in the development of the economy but it seems to be excluded in many matters, for instance, institutions like BITRI and BIUST were established to support the private sector, with knowledge, however

more often these seem to be providing the technologies to the communities directly, instead of providing the intellectual support to business owners who will, in turn, bring the technologies to the people. In only limited cases where you will find linkages between the private sector and parastatals/ government with the private sector being able to benefit from using facilities in those institutions. The institutions in return benefit from knowledge exchange and collaborations. Several wonderful plans and initiatives have been discussed and developed by the government. However, the implementation of these initiatives is always a problem due to the lack of collaborative effort between government, private sector, and research institutions. This creates a disconnect that inhibits the successful implementation of major projects in the country. There is need for the creation of synergy between government and private institutions in Eco-innovation development.

- *Political interference*- Politics influence decision making at ministerial levels. This has led to long bureaucratic processes thereby inhibiting progress in policy implementation which is sometimes caused by the frequent changes in leadership. Establishing an independent national institution outside the ministry to assist in coordinating innovation matters and improving coordination with various actors is necessary.

- *Knowledge importation* is a major barrier when there is no proper knowledge transfer to the local people, leading to continued dependence on foreign expertise. This can be taken care of if there is an independent institution responsible for these away from the ministry.

- *Lack of clarity on what types of research, technologies or innovations are needed*. The policy on research, technology and innovation lacks clarity and definition of priorities on sectors that need technology development in Botswana. Furthermore, it needs direction on what needs to be done to support the technologies and defined timelines on targets that must be reached. The policy under review is expected to address the limitations of the first one and create cohesiveness between stakeholders in the development of eco-innovative technologies.

3.3 Eco-innovation Related Policies and Institutions in Ghana

3.3.1 Overview

Ghana is located in West Africa next to the Gulf of Guinea, sharing borders with Côte d'Ivoire to the west, Togo to the east and Burkina Faso to the north. It has an area of 238,540 Km^2, with a population of 29,767,108 people[7]. It shares borders with Côte d'Ivoire to the west, Burkina Faso to the north, and Togo to the east. To the south are the Gulf of Guinea and the Atlantic Ocean. The country is divided into 16 administrative regions and 254 Metropolitan, Municipal and District Assemblies (MMDAs). Ghana's Human Development Index (HDI) for 2019 is 0.611- which put the country in the medium human development category positioning it at 138 out of 189 countries and territories. Ghana participated in the UN Stockholm Conference on Human Environment (1972) which led to the establishment of the Environmental Protection Council (EPC) in 1974, now (EPA). The Council was tasked to coordinate all environmental matters and advise the government on issues relating to the environment. This marked Ghana's first experience in mainstreaming environmental concerns in our developmental process. Ghana has a huge potential

[7] https://countryeconomy.com/countries/ghana

to grow and transform its economy through industrialization to create jobs and ensure the equitable distribution of wealth. The fundamental goal of the Government of Ghana's development agenda is to achieve macro-economic stability and grow the economy to a middle-income status by 2020. The Constitution of Ghana 1992 amended in 1996 was approved at the Referendum held on April 28, 1992, and promulgated by the Constitution of the Fourth Republic of Ghana (Promulgation) Law, 1992. It was last amended in 1996 by the Constitution of the Republic of Ghana (Amendment) Act, 1996. The Constitution places an obligation on every citizen as a duty to protect and safeguard the environment for prosperity. Section 41(k) stipulated that '*It shall be the duty of every citizen to protect and safeguard the environment*.' This is in tandem with the concept of Eco-innovation where the welfare of the people and the environment are very critical.

3.3.2 Enablers and/or constrainers of Eco-innovation in Ghana

Ghana has a long history of developing the STI sector. This bides well in anchoring research and development that is aimed at promoting Eco-innovation. The Government and its development partners have been at the forefront in supporting the sector. For instance, the World Bank approved a financial package of $17.2 million to fund the Ghana Climate Innovation Centre (CIC) located at Ashesi University College in Berekusu in the Eastern region. The CIC was launched in May 2016 to support Ghana's National Climate Change Policy (NCCP) of 2013, spearheaded by the Ministry of Environment, Science, Technology and Innovation. The centre hoped to support over 100 local clean technology companies to develop and scale innovative solutions to climate change. The Ghana CIC targeted to help over 300,000 Ghanaians increase resilience to climate change within ten years. Furthermore, through its support to local clean technology ventures, the centre was expected to mitigate 660,000 tons of CO_2 and contribute to the production of over 260 million kWh of clean energy. In Ghana, consumer protection has played a pivotal role in Eco-innovation.

Eco-innovation, green economy, green growth, Clean Development Mechanisms and related concepts have in recent years been considered in Ghana's development plans, policies and strategies. Going forward, policies, strategies and plans will increasingly have the basic principles of Eco-innovation, green growth, green economy or clean development mechanisms.

Ghana has faced a few challenges in embracing new technology. One main challenge is the lack of incentives from the government. Individuals in Ghana have come up with new innovative ideas that needed support from the government for their advancement but no effort is made to motivate them. This makes the innovators lose hope and their ideas killed. The study also reported that the lack of clarity on most of the government policies is one of the constraints to Eco-innovation in Ghana.

3.3.3 Eco-innovation related Policies and Frameworks in the Environment and Natural Resources Sector- Ghana

The table below provides a list of national documents that support the mainstreaming of Eco-innovation/Green Economy, implementation period and the implementation agencies. Some of the key policy documents in Ghana that enhance Eco-innovation have been provided in Table 8.

Table 8: National documents that support the mainstreaming of Eco-innovation/Green Economy, implementation period and the implementation agencies

State Programme/Strategy/Action Plan	Implementation Period (Years)	Main Implementation Agency
Ghana's Constitution 1992		
Development Documents		
Medium-term national development policy framework: Ghana Shared Growth and Development Agenda (GSGDAII) (2014)	2010-2013	National Development Planning Commission (NDPC)
National Employment Policy (2012)	2012-2016	Ministry of Employment and Social Welfare
National Health policy	2007	Ministry of Health
Health Sector Gender Policy	2009	Ministry of Health
Health Sector Gender Policy	2009	Ministry of Health
National Gender and Children Policy (2004)	Under review	Ministry of Women and Children's Affairs
National Disaster Management Organisation Act 1996	1996	National Disaster Management Organization
Energy		
National Energy Policy of Ghana	2010	Ministry of Energy
Renewable Energy Act	2011	Ministry of Energy
Feed-in Tariff scheme		Ministry of Energy
Agriculture		
Medium-Term Agricultural Sector Investment Plan (METASIP)	2011-2015	Ministry of Food and Agriculture
Tree crops policy	2012	Ministry of Food and Agriculture
Food and Agriculture Sector Development Policy (FASDEP II) 2007	2007	Ministry of Food and Agriculture
Environment		
National Environmental Policy (NEP)	2012	Ministry of Environment, Science, Technology and Innovation (MESTI)
National Climate Change Policy	2013	MESTI
National Forest and Wildlife policy	2012	MESTI
Environmental Sanitation Policy	2010	Ministry of Local Government
National Land Policy of 1999 as Amended in 2002	1999	MESTI
National Water Policy	2007	Ministry of Water Resources, Works and Housing
National Biodiversity Strategy and Action Plan	2002	MESTI

The National Environmental Policy (NEP) of 2012 is based on a broad vision founded on and directed by respect for all relevant principles and themes of environment and sustainable

development. According to the Policy, Ghanaians are entitled to an environment that is not harmful to their health and wellbeing and are enjoined to have the environment protected for the benefit of present and future generations through reasonable legislative and administrative measures (GoG, 2012a). Among other things, the policy describes the Government's focus in the medium term on shifting the economy from the current factor-driven one to an efficiency-driven one. "*This will be achieved by anchoring industrial development on the conversion of Ghana's natural resources into value-added products with an emphasis on agro-based manufacturing, downstream oil and gas and mineral processing and manufacturing, tourism, and creative arts"* (GoG, 2012a). The policy reconfirms the government's commitment to the polluter pays principle. "*Those responsible for environmental damage must be liable for the repair caused both to the physical and human environments. They must also be held responsible for the costs of preventive measures to reduce or prevent further pollution and environmental damage.*" On Green economy, the policy calls for macro-economic assessments with a view to better understanding how government policies and public and private investment can help achieve the fundamental macroeconomic objectives of income growth, economic development/diversification, job creation and which follows a path that contributes to social equity and environmental improvement. The policy endorses the concept of Sustainable Consumption and Production that calls for minimizing the use of natural resources, toxic materials and emissions of waste in production and consumption processes. It envisages a holistic approach to minimizing negative environmental impacts from production and consumption whilst considering the practical implementation of strategies to achieve sustainable development. The policy also ensures that there is environmental quality control programme where environmental impact assessments (EIA) of all new investments that would be deemed to affect the quality of the environment are undertaken. This policy thus makes a high-quality environment a key element supporting the country's economic and social development which are core principles of Eco-innovation, green economy as well as related concepts such as green cities, green innovation etc.

Transformative Innovation Policy (TIP) of 2018- Ghana joined the ***Transformative Innovation Policy (TIP) Africa Exploratory Hub*** in 2018 with a special focus on the case study of the E-waste management system in Ghana. The Transformative Innovation Policy Consortium (TIPC) is a multi-country initiative for STI policies that promote the transformation of systems and societies to foster environmental sustainability, achieve more equitable income distribution and help address social challenges including gender, inequality, and exclusion. In Ghana, the TIP project was implemented by Council for Scientific and Industrial Research (CSIR)-Science and Technology Policy Research Institute (STEPRI) in collaboration with the Ministry of Environment, Science, Technology and Innovation (MESTI) and the University of Ghana (UG) with technical support from the Science Policy Research Unit (SPRU) at the University of Sussex, UK.

The Environmental Fiscal Reform Policy of 2013 seeks to support sustainable development, environmental protection, climate change and green principles and policies. It complements existing environmental and climate change policies in the country by offering more robust measures on preserving and promoting a clean environment. It does this by addressing waste management; deforestation and biodiversity; land degradation as a result of mining activities; vehicular, industrial and energy emissions. The policy is underpinned by environmental scarcity, the need to control negative externalities and efficient utilization of resources by incorporating the

polluter-pays principle, user-pays principle, the prevention principle, and the precautionary principle.

Hazardous and Electronic Waste Control and Management Act of 2016 was enacted to improve e-waste management in Ghana through an integrated multi-stakeholder approach. Act 917 provides for the establishment of a national E-waste plant with the involvement of the private waste recyclers to manage and recycle E-waste in Ghana. It has led to the formation of a consortium of partners and is mainly funded by European Union with a general aim of promoting sustainable growth, alleviating poverty, increasing human wellbeing, and preventing environmental pollution, by supporting the effective implementation of Ghana's legal framework for e-waste management. This requires producers and importers to register with Ghana's Environmental Protection Agency (EPA)[8] and pay a pre-emptive eco-tax for imported electronics, which finances the enforcement of the legal framework for e-waste management and the formalisation of informal actors. Since 2000, a number of policies, projects and activities were put in place to address the E-waste challenge. Most significant was the promulgation of this Act (Act 917) and ***the Hazardous, Electronic and Other Wastes, Control and Management Regulations (LI 2250) in 2016*** by the Government. Also, of significance is that in 2017 the Government signed an agreement with GIZ on the commencement of an E-waste management project. Furthermore, in 2018, technical guidelines on e-waste were established and Société Générale was charged to collect an eco-levy. The national E-waste management system enables the Environmental Protection Agency (EPA) to regulate actors including collectors and dismantlers along the E-waste value chain.

National Plastic Waste Management Policy of 2019 supports the country's public, private and civil society sectors in transitioning to a circular plastics economy, which directly addresses the root cause of plastic pollution by fundamentally reshaping the way plastics are produced, used and re-used. The policy is expected to enhance the proper management of plastic wastes that have become a menace to the people of Ghana by ensuring that the polluters pay fines for polluting the environment with the wastes.

The Ghana National Climate Change Policy (NCCP) of 2013 affirms Ghana's resolve to lessen the potential hardships that climate change impacts may pose to sustainable development. The policy seeks to provide strategic directions and coordinate issues of climate change in Ghana, bearing in mind its linkages with development. This is to ensure the mainstreaming of the climate-proofing agenda into national development through mutually reinforcing and integrating the climate change issues into the national planning and budgeting processes. The implementation of the National Climate Change Policy is not the singular responsibility of the central government but depends to a large extent on the involvement and participation of all relevant stakeholders, including the private sector, NGOs and civil society organizations. The Policy is built on seven (7) systematic pillars (GoG, 2013) and its objective is to mitigate and ensure an effective adaptation in key sectors of the economy, such as agriculture and food security, natural resources management, energy, industry and infrastructure among others.

[8] http://www.epa.gov.gh/epa/

The Ministry of Environment, Science Technology and Innovation (MESTI) of Ghana in November 2012, launched ***the National Climate Change Adaptation Strategy (NCCAS) of 2012*** Guidelines for Acquisition of Environmental Permits for Compost Projects Documents and Accessing the Global Carbon Credit Using Composting Guideline and Process. The main objectives stated in the NCCAS document were to improve societal awareness and preparedness for climate change and enhance the mainstreaming of climate change into national development planning (GoG, 2012b). Policies that promote the wellbeing of the people, as well as focus on the conservation of the environment, are considered eco-innovative.

The overall goal of ***the Environmental Sanitation Policy (ESP) of 2010*** is to develop a clear and nationally accepted vision of environmental sanitation as an essential social service and a major determinant for improving health and quality of life in Ghana. The policy recognizes that ensuring good sanitation is the responsibility of all citizens, communities, private sector enterprises NGOs and institutions of Government (GoG, 2010a). All these actors have an essential part to play in maintaining a high standard of environmental sanitation so that domestic and commercial activities have no prejudicial effect on the health or the living and working environment of others. The policy lays the basis for developing a systematic approach and framework for identifying and harnessing resources for value-for-money (economy, effectiveness and efficiency) services to all which are in tandem with the concept of Eco-innovation. Box 3 below provides an example of a private company involved in waste management in Ghana.

Box 3: Zoomlion Company Limited in Ghana

Zoomlion Company Limited (a waste management company) realized the pile of waste in the Ghanaian environment and decided to design a business model to help manage the waste. The company helps to create jobs for Ghanaians while managing the waste that is polluting the environment, water and the atmosphere. The company diversified its services by producing organic manure from the biodegradable waste collected from the field. It also retrieves some plastic waste which is sold to plastic companies in Ghana. Zoomlion Ghana Limited has recently received an award for its work in the sanitation and waste management sector in Ghana. The award was presented to the company by the African Clean-up Initiative (ACI)). It is another important achievement in the history of Zoomlion, the company that deals with waste management in Ghana. The Ghanaian company has been hailed for its efforts by NGOs, including the African Clean-Up Initiative (ACI).
https://www.zoomlionghana.com/about-zoomlion-ghana

The National Forest and Wildlife Policy, 2012 of Ghana aims at the conservation and sustainable development of forest and wildlife resources for the maintenance of environmental stability and continuous flow of optimum benefits from the socio-cultural and economic goods and services that the forest environment provides to the present and future generations in line with Eco-innovation principles. This policy also ensures that Ghana's commitments under international agreements and conventions are fulfilled. It provides for management and enhancement of the ecological integrity of Ghana's forest, savannah, wetlands and other ecosystems for the preservation of vital soil and water resources, conservation of biological diversity, and enhancing carbon stocks for sustainable production of domestic and commercial produce/products. It promotes the rehabilitation and restoration of degraded landscapes through forest plantation development, enrichment planting, and community forestry informed by appropriate land-use practices to enhance environmental quality and sustain the supply of raw materials for domestic and industrial consumption and environmental protection (GoG, 2012c). Development of viable

forest and wildlife-based industries and livelihoods, particularly in the value-added processing of forest and wildlife resources that satisfy domestic and international demand for competitively-priced quality products, mechanisms for transparent governance, equity sharing and citizens' participation in forest and wildlife resource management has also been provided for in the Policy. It is therefore very important to understand and develop eco-innovative policies and strategic actions for conserving and protecting the integrity of the forest and wildlife resources.

The National Land Policy of 1999 as Amended in 2002 of Ghana aims at the judicious use of the nation's land and natural resources in support of the different socio-economic activities undertaken, in accordance with sustainable resource management principles and to maintain viable ecosystems. This is consistent with Eco-innovation. The policy seeks to innovatively address some of the fundamental problems associated with land management in the country. These include general indiscipline in the land market, characterized by land encroachments, multiple land sales, use of unapproved development schemes, haphazard development, indeterminate boundaries of customary ownership, resulting from lack of reliable maps and plans, compulsory acquisition by the government of large tracts of land, which have not been utilized, a weak land administration system and conflicting land use, such as, the activities of mining companies, which leave large tracts of land denuded as against farming, which is the mainstay of the rural economy, and the time-consuming land litigation processes (GoG, 2002).

The National Water Policy (NWP) of 2007 of Ghana strives to provide a framework for the sustainable development and utilization of Ghana's water resources. It targets all water users, water managers and practitioners, investors, decision-makers and policymakers within the central and decentralized government structures such as the district assemblies, non-governmental organizations and international agencies (GoG, 2007). The Policy outlines the various cross-sectoral issues related to water use and the links to other sectoral policies such as those relating to energy, Hygiene, Environmental Sanitation. This policy promotes some of the principles of Eco-innovation such as those relating to sustainability and efficient utilization of resources.

The National Biodiversity Strategy and Action Plan (NBSAP) of 2016: Ghana signed and ratified the Convention on Biological Diversity in 1992 and therefore it had the obligation to develop a national strategy for the sustainable use of the country's biological resources. Within the framework of national development agenda, Sustainable Development Goals, National Climate Change Action Plan, Forestry Development Master Plan and the international conventions that Ghana has signed, the national biodiversity conservation vision is that (GoG, 2016): *"By 2030, effective systems would be in place to ensure that biodiversity in Ghana is valued, conserved, restored and wisely used to maintain ecosystem services, and sustain life support services for a healthy planet while ensuring continuous and equitable sharing of the costs and benefits arising therefrom, to the well-being, prosperity and security of all Ghanaians."* Following from this vision the mission is: *"To take effective and urgent actions to minimise the loss of biodiversity in order to ensure that by 2030 ecosystems in Ghana are resilient and continue to provide essential services, thereby securing the country's variety of life, and contribute to human wellbeing and poverty eradication."*

As a signatory to ***the international convention on biodiversity*** the goal of the NBSAP is: *"To pursue effective policies, regulations, and programmes that would ensure that biodiversity is*

valued, conserved, restored and wisely used to maintain ecosystem services, sustain life support services and promote the continuous and equitable flow of benefits to all Ghanaians." These reflect on the various aspects of Eco-innovation and related concepts that are key to this study.

The key institutions active in the Environment and Natural Resources sector in regard to Eco-innovation in Ghana have been provided in Table 9. Their roles have also been provided.

Table 9: Eco-innovation relevant Institutions and actors in the Environment sector- Ghana

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Environment, Science Technology and Innovation (MESTI)	MESTI is responsible for setting standards and guidelines for environmental quality.
Environmental Protection Agency (EPA)	It oversees the implementation of the National Environment Policy. EPA Ghana's mission is to manage, protect and enhance the country's environment and seek common solutions to global environmental problems.
Council for Scientific and Industrial Research (CSIR)	CSIR and its member institutions support and undertake research and development activities.
Ministry of Local Government and Rural Development	• Co-ordination and formulation of environmental sanitation policy; • Developing and issuing technical guidelines on environmental sanitation services and their management; • Promulgation of national legislation and model by-laws; • Direction and supervision of the National Environmental Sanitation Policy Co-ordination Council.
Metropolitan, Municipal and District Assemblies (MMDAs)	The MMDAs are responsible for administering the Local Governance Act of 2016, Act 936. The MMDAs have the ultimate role to seek the necessary approvals and implement the district's development plan. Some of the responsibilities include: • Waste Management • Public Health Management • Environmental Monitoring • Planning, Monitoring and Public Relations
The District Assemblies' Environmental Health and Management Departments	Supported by the EPA, shall ensure that all developments or activities likely to have a substantial impact on the environment are subject to Environmental Impact Assessment. They shall also monitor and enforce compliance with the impact statements. Developers shall be required to prepare and submit environmental management plans in accordance with the provisions of the Environmental Protection Agency Act 490, 1994.
National Development Planning Commission (NDPC)	The NDPC was established under Articles 86 and 87 of the 1992 Constitution as part of the Executive. The National Development Planning Commission Act, 1994, (Act 479) and the National Development Planning (System) Act, 1994, (Act 480), provide the

	core legal framework for the establishment of the Commission and the performance of its functions. Under Article 87 of the Constitution, the core mandate of the Commission is to "advise the President on development planning policy and strategy" and, "at the request of the President or Parliament, or on its own initiative," do the following: (a) Study and make strategic analyses of macro-economic and structural reform options; (b) Make proposals for the development of multi-year rolling plans taking into consideration the resource potential and comparative advantage of the different districts of Ghana; (c) Make proposals for the protection of the natural and physical environment; (d) Make proposals for ensuring the even development of the districts of Ghana by the effective utilisation of available resources; and (e) Monitor, evaluate and coordinate development policies, programmes and projects. The Commission, according to the Constitution, "shall also perform such other functions relating to development planning as the President may direct".
Forestry Commission	The Forestry Commission of Ghana is responsible for the regulation of utilization of forest and wildlife resources, the conservation and management of those resources and the coordination of policies related to them.
Lands Commission	The Lands Commission among others provides Land Services consisting of managing public and vested lands; surveying, mapping and maintaining national territorial boundaries; developing and maintaining national and geodetic reference network nationwide; registering title to land and other interests in land, registering deeds and other instruments affecting land, assessing compensation upon compulsory acquisition, assessing stamp duty and determining values of properties for letting, sale, purchase and rating. The Commission comprises of four Divisions: Lands Registration Division; Land Valuation Division; Survey and Mapping Division; and Public and Vested Lands Management Division.
Water Resources Commission (WRC)	The WRC was established by an Act of Parliament (Act 522 of 1996) as the overall body responsible for water resources management in Ghana. WRC Act 522 of 1996 provides a comprehensive law to establish a separate water resources management institution in Ghana. The mandate of the Water Resources Commission is specifically to: Regulate and manage the utilization of water resources; Coordinate the activities of the various agencies (public and private) in the development and conservation of water resources; Enforce, in collaboration with

	relevant agencies, measures to control water pollution; and Be responsible for appraising water resources development project proposals, both public and private, before implementation.
Land Use and Spatial Planning Authority (LUPSA)	LUPSA has the responsibility to revise and consolidate the laws on land use and spatial planning, provide for sustainable development of land and human settlements through a decentralised planning system, ensure judicious use of land to improve quality of life, promote health and safety in respect of human settlements and to regulate national, regional, district and local spatial planning, and generally to provide for spatial aspects of socio-economic development and related matters. The Authority is mandated to undertake the following services: • Preparation of Spatial Plans (Spatial Development Frameworks; Structure Plans and Local Plans); • Rezoning and Change of Use • Plan Revision and Amendments • Layout Extracts • Sub-division • Site Selection • Processing Development and Building Permit Applications • Provision of Certified true Copies of Planning Documents and Permits • Provision of Planning Advisory Services

3.3.4 Eco-innovation related Policies and Frameworks in the Trade and Industry Sectors-Ghana

Industry in Ghana accounts for about 25.3% of the total GDP. However, Ghana's industrial production is rising at a 7.8% rate, giving it the 38th fastest-growing industrial production in the world due to government industrialisation policies. Ghana's most important manufacturing industries include electronics manufacturing, car manufacturing, electric car manufacturing, automotive manufacturing, light manufacturing, aluminium smelting, food processing, cement, and small commercial shipbuilding. Foreign capital has increased in recent years. Most products are for local consumption and exportation. Other industries include the production of food and beverages, textiles, chemicals and pharmaceuticals, and the processing of metals and wood products (GoG, 2019).

Ghana's Trade Policy of 2005 was guided by developments which have taken place in the arena of international trade under the General Agreement on Trade and Tariff s (GATT) and World Trade Organisation (WTO), trade agreements between Ghana and major trading partners as well as the country's economic development policy. This policy was set within the context of Ghana's strategic vision of achieving middle-income status by 2012 and becoming a leading agro-industrial country in Africa. The policy provided clear and transparent guidelines for the implementation of the government's domestic and international trade agenda (GoG, 2004). It is also designed to ensure a consistent and stable policy environment within which the private sector and consumers can operate effectively and with certainty. This policy emphasized two parallel strategies: an

export-led industrialization strategy and domestic market-led industrialization based on import competition. These strategies were supported through the promotion of increased competitiveness of local producers in the domestic and international market based on fair and equal competition and by introducing an import and domestic trade regime that promotes and protects consumer interests. ***A strategic plan: The Trade Sector Support Programme (TSSP***) was launched in 2006 to implement the policy prescriptions in the Ghana National Trade Policy of 2005. Essentially this consisted of a series of projects aimed at improving the legal and regulatory environment for business and consumers. Key to this policy, it had provisions on Consumer Protection and Fair Trade: dealing with issues of health and safety of consumers; as well as Intellectual Property Rights (IPRs). Unfortunately, these policy documents do not mention environmental sustainability.

Ghana's Industrial Policy of 2011 was designed to promote increased competitiveness and enhanced industrial production, with increased employment and prosperity for all Ghanaians. It will also provide a broader range of fair-priced, better quality products for the domestic and international markets. The key development objectives of the Industrial Policy are to expand productive employment in the manufacturing sector; expand technological capacity in the manufacturing sector; promote agro-based industrial development; and promote the spatial distribution of industries to achieve a reduction in poverty and income inequalities. In this regard, this Industrial Policy represents the set of specific policy instruments and measures to be applied to improve access to competitive factors of production within the economy; and enhance productivity, efficiency and growth of Ghana's manufacturing sector (GoG, 2011). Its provisions for electricity and water efficiency programs and several dimensions of cleaner production - efficient use of materials, technology promotion, voluntary standards and self-regulatory measures have the potential to accelerate green industry consistent with Eco-innovation.

The draft Occupational Safety and Health (OSH) Policy of 2004 of Ghana, aims *'to prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing as far as reasonably practicable the cause of the hazards in the working environment and, therefore the risk to which employees and the public may be exposed'*. The policy was derived from provisions of the International Labour Organization (ILO) Conventions 155 and 161. The policy promotes awareness creation on Occupational Health and safety which are relevant to the safety and welfare of the workers. These provisions, therefore, qualify this policy to be in line with some aspects of Eco-innovation.

Table 10: Eco-innovation relevant Institutions and actors in the Trade and Industry Sector-Ghana

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Trade and Industry	• Policy formulation • Facilitating enterprise development including Micro, Small and Medium Enterprise (MSMEs). • Development and enforcement of standards in trade and industry. • Promoting and facilitating Ghana internal and export trade with emphasis on diversification and value-addition • Promoting and facilitating Ghana's active participation in Global Trade through participation in multilateral and

	Plurilateral institutions as well as champion Ghana's market expansion drive. • Facilitating the development of the Private Sector • Facilitating innovation and entrepreneurship with both formal and informal sectors to enhance factor productivity. • The Ministry is involved in activities geared towards Production, commerce and creation of gainful employment.
Ministry of Business Development	• To facilitate the improvement of business in Ghana Promote the development of the MSME Sector for job creation • To increase the entrepreneurial capacity of the youth • To nurture, build and promote medium to large size indigenous Ghanaian business giants • To enhance the image of Ghana as an investment destination through effective branding
Ghana Export Promotion Council (GEPC)	• Create awareness about export in the country • Identify products suitable for export and locate appropriate markets for them • Organise exhibitions and trade fairs in and outside the country to create goodwill for products made in Ghana • Provide Ghanaian exporters with all the required help, so that they can enter competitive markets abroad • Organise market missions to facilitate meetings between exporters and prospective buyers from abroad • Offer advice to exporters on export marketing • Train exporters and staff from export institutions to enhance their export marketing skills • Recommend to the government the assistance and/ or incentives that Ghanaian exporters need • Provide businessmen and exporters travelling overseas from Ghana with relevant information and knowledge about target markets
Ghana Free Zones Board (GFZB)	GFZB provides a one-stop service centre for Free Zone investors. The Board's main role is to facilitate, regulate and monitor activities in the Free Zones.
Ghana Investment Promotion Centre (GIPC)	GIPC role is to encourage and promote investments in Ghana, to provide for the creation of an attractive incentive framework and a transparent, predictable and facilitating environment for investments in Ghana.
Ghana Standard Authority (GSA) formerly Ghana Standards Board	GSA is a Government of Ghana agency responsible for the maintenance of acceptable standards for product and services and sound management practices in industries and public institutions in Ghana.
National Board for Small Scale Industries (NBSSI)	The functions of NBSSI: • To contribute to the creation of an enabling environment for small-scale enterprise development.

	• To contribute to the development of an enterprise culture in Ghana by facilitating access to credit. • Facilitate MSEs access to substantial and high-quality Business Development Services for their development.
Association of Ghana Industries (AGI)	As the leading voice of manufacturing industries in the country, AGI is dedicated to: • Advocating policies that advance the growth and development of industries; • Facilitating international trade through the exhibition of member products in countries across the sub-region; • Strengthening national industry associations through the sharing of knowledge, experience and critical information; • Providing members with a vast network of contacts, especially in the West African sub-region; • Hosting the industry and technology exhibition to promote members' goods.

3.3.5 Eco-innovation related Policies and Frameworks in the Agriculture sector-Ghana

Agriculture is the main driving force behind Ghana's economy, accounting for approximately 42% of the country's GDP and employing 54% of its workforce. Ghana is the world's largest cocoa producer after Cote d'Ivoire. Ghanaian cocoa is grown by small-holder farmers. The cocoa industry in Ghana is vital to the strength of the formal economy and it employs 1.5 million people in production and transport. In the medium-term, the government's overall goal is to "build a prosperous society" as enshrined in the ***National Medium-Term Development Policy Framework (NMTDPF), "Agenda for Jobs: Creating Prosperity and Opportunity for All" (2018-2021)***. This goal entails: (i) optimising the key sources of economic growth; (ii) building a strong and resilient economy, capable of withstanding internal and external shocks; (iii) establishing a competitive and enabling business environment; (iv)transforming agriculture and industry; and (v) developing a robust tourism and creative arts industry. Unfortunately, environmental sustainability is glaringly absent in the policy framework. The purpose of the medium-term development policy framework is to implement the vision, policies and programmes outlined in the President's ***Coordinated Programme of Economic and Social Development Policies (CPESDP)*** - named Agenda for Jobs: ***Creating Prosperity and Equal Opportunity for All (2018-2024).*** The Government of Ghana under the Agenda for Jobs outlines the vision and approaches in addressing the socio-economic challenges through specific sets of policies, strategies and programmes. The policies and programmes seek to remove the bottlenecks stifling the growth of the private sector and provide the enabling environment for growth, job creation and prosperity for all. The thrust of the Government's medium-term development programmes is to stabilise the economy characterised by strong, diversified and resilient growth through the effective and efficient implementation of flagship programmes and projects such as; Planting for Food and Jobs, Rearing for Food and Jobs, One District - One Factory, One District - One Warehouse and One Village - One Dam.

The first ***Food and Agriculture Sector Development Policy (FASDEP)*** was developed in 2002 as a framework for the implementation of strategies for the modernisation of the agricultural sector. The strategies in that policy were based on the Accelerated Agricultural Growth and Development

Strategy (prepared in 1996) and were designed to forge linkages in the value chain. Based on the role of agriculture in the national development framework, the objectives for the food and agriculture sector policy are food security and emergency preparedness; improved growth in incomes; increased competitiveness and enhanced integration into domestic and international markets; sustainable management of land and environment; Science and Technology Applied in food and agriculture development; and improved Institutional Coordination, consistent with Eco-innovation. A good example is where a Ghanaian company (Temale) promotes organic farming in the country by paying the organic farmers good prices for their produce. The aim is to protect the environment from pollution with agrochemicals whilst protecting many lives. Tumu Deanery Integrated Development Programme (TUDRIDEP) is another example where farmers are taught to avoid the use of inorganic fertilizers in the western part of the country. The use of new technology has given rise to the use of energy-saving stoves that is a form of clean energy.

The Agriculture sector in Ghana has various stakeholders with various roles as provided in Table 11.

Table 11: Eco-innovation relevant Institutions and actors in the Agriculture Sector- Ghana

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Food and Agriculture (MoFA)	The Ministry of Food and Agriculture's mission is to promote sustainable agriculture and thriving agribusiness through research and technology development, effective extension and other support services to farmers, processors and traders for improved livelihood. They have partnered with IPA on an evaluation of crop insurance in Northern Ghana. MoFA leads in policy formulation and M&E for the development of agriculture in Ghana while implementation is by the decentralised levels as stipulated by the decentralised law i.e., Local Government Act, 2016 (Act 936). MoFA and the agricultural departments of the Regional Coordinating Councils (RCCs) and MMDAs operate at three administrative levels; national, regional and district.
Regional Agriculture Departments (RADs)	RADs are responsible for the coordination and monitoring of agricultural projects and programmes in their respective MMDAs. The RADs are under the Regional Coordinating Council and are expected to maintain the technical relationship with MoFA national office and the MMDAs.
The District Agricultural Departments (DADs)	DADs are responsible for the following: provision of agricultural services to stakeholders; determination of district agricultural priorities; and development and implementation of plans and projects. For efficient and effective service delivery, districts are demarcated into zones and operational areas. An operational area is manned by an Agricultural Extension Agent (AEA).

3.3.6 Eco-innovation related Policies and Frameworks in the Energy sector-Ghana

Energy is a major requirement for economic growth and development. There is a direct link between energy use, economic growth and standard of living. At the same time, energy supply has serious financial and environmental implications to such an extent that uncontrolled energy

consumption will have adverse consequences on the economy and the environment. The best approach to energy supply is, therefore, a combination of supply and demand option that ensures the least economic and environmental impacts.

The Ghana National Energy Policy of 2010 provides a concise outline of the Government's policy direction to Ghana's Energy sector. Ghana is well endowed with a variety of energy resources including biomass, hydrocarbons, hydropower, solar and wind. It can produce modern bio-fuels and is exploring options to develop nuclear energy. The Policy provides a brief account of the various policy directions in the energy sector (GoG, 2010b). It acknowledges the concerns relating to power and identifies appropriate measures to address them. It indicates the state of affairs in the energy sector concerning petroleum issues and the necessary Government interventions required to support and enhance the growth of this sector. The Renewable Energy sub-sector covers biomass, mini-hydro, solar and wind resources whose goals are to increase the proportion of renewable energy in the total national energy mix and ensure its efficient production and use and also contribute to the mitigation of climate change. The major challenges facing the Renewable Energy sub-sector include sustaining exploitation of wood fuel by improving efficiency; reducing the high costs of solar and wind energy technologies, which make them uncompetitive; and reducing the high cost of waste collection and management for waste-to-energy technologies which is consistent with Eco-innovation. The renewable energy policy aims to convert most of the wastes generated in municipal activities, industrial operations and agricultural operations to energy. This comprehensive waste management approach will enable Ghana to generate a reasonable amount of energy from its wastes. The policy focuses on removing the obstacles that have constrained the promotion and implementation of energy efficiency and conservation measures. The proposed measures to promote energy efficiency and conservation are fiscal incentives, awareness creation, institutional and human resource capacity development, and financial intermediation.

The Strategic National Energy Plan (SNEP) 2006-2020 was developed for the period 2006-2020 by the National Energy Commission to contribute to the development of a sound energy market that would provide sufficient, viable and efficient energy services for Ghana's economic development through the formulation of a comprehensive strategy that identifies the optimal path for the development, utilisation and efficient management of energy resources available to the country. The SNEP presents an outlook of energy in Ghana for the period 2006-2020 based on the economic growth rates forecasted in the ***Ghana Poverty Reduction Strategy (GPRS) II***. The SNEP contains the vision for Ghana to become an "energy economy" that ensures the reliable production and distribution of high-quality and sustainable energy services to all sectors of the economy while developing Ghana into a major exporter of energy, without compromising on environmental objectives (GoG, 2006; UNEP, 2015). SNEP recognizes that there is a direct link between energy use, economic growth and standard of living and that energy supply has serious financial and environmental implications to such an extent that uncontrolled energy consumption will have adverse consequences on the economy and the environment (GoG, 2006). The best approach to energy supply is, therefore, a combination of supply and demand option that ensures the least economic and environmental impacts therefore directly supporting Eco-innovation. The SNEP energy policy framework has thus been formulated within the existing socio-economic and environmental policies; the linkages of the energy sector with other sectors and international linkages of the sector.

The GoG has identified renewable energy as one of the options that could contribute to the overall energy supply mix and minimise the adverse effects of energy production on the environment. Renewable energy programmes and projects implemented recently have demonstrated that renewable energy interventions have enormous potential to reduce poverty and improve the socio-economic development of the country, particularly, in rural communities.

The Renewable Energy Master Plan (REMP) of 2019 has been developed to provide an investment-focused framework for the promotion and development of the country's rich renewable energy resources for sustainable economic growth, contribute to improved social life and reduce adverse climate change effects. The REMP aims to achieve the following by 2030: increase the proportion of renewable energy in the national energy generation mix from 42.5 MW in 2015 to 1363.63 MW (with grid-connected systems totalling 1094.63 MW); Reduce the dependence on biomass as the main fuel for thermal energy applications; provide renewable energy-based decentralised electrification options in 1,000 off-grid communities and promote local content and local participation in the renewable energy industry.
The REMP also prescribes action plans for all Renewable Energy Technologies (RETs). For each of the RET areas (solar, wind, hydro, biomass, etc.), the action plan analysed the resource availability, opportunities in developing the resource, and recommends interventions for their promotion and development. Further details and actions are provided for each of the technologies/ interventions under each resource with specific considerations given to the challenges and strategies to promote it.

One of the main goals of the ***Renewable Energy Act of 2011 (832***) was to increase the share of modern forms of renewable energy to 10% in terms of power generation. According to estimates by the Ministry of Energy and Petroleum, the government will need $1 billion in investments in renewable energy from 2012 to 2020 to achieve this target. The Act defines renewable energy to mean 'energy obtained from non-depleting sources including wind, solar, hydro…biomass, biofuels, geothermal energy, and ocean energy,' inter alia. To ensure the diversification of electricity supplies in ways that would improve access to electricity in particular and safeguard energy security in general, the Act not only envisages a framework to support the development and utilization of these renewable energy sources but also the creation of an enabling environment to attract investment in those sources. The Act promises a well-integrated long-term scheme that would guarantee project bankability for private investors in the deployment of renewables. In line with the Renewable Energy Act, 2011 (Act 832), the Ministry of Energy will implement the plan through the REMP Coordinating Unit (REMP-CU) (See Figure 3).

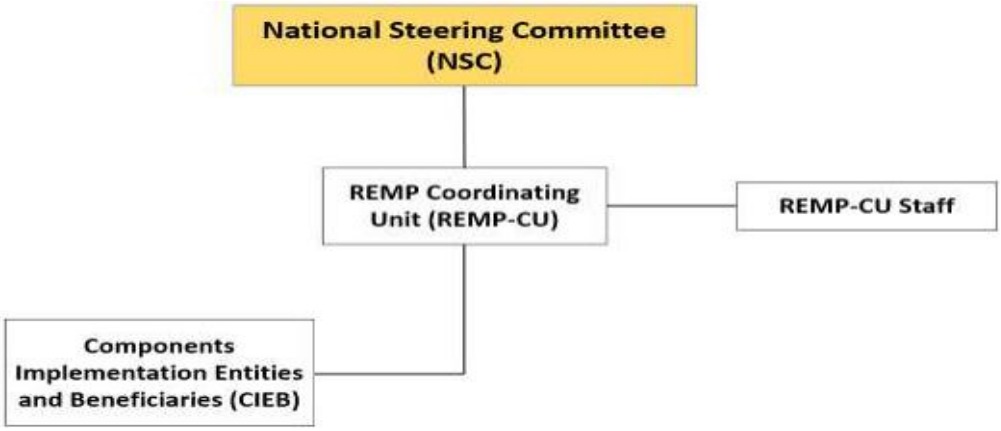


Figure 3: The REMP Implementation and Governance Structure

Although the Public Utilities Regulatory Commission (PURC)[9] is given the discretion to determine the duration of and/or modification of licenses, the PURC will likely consider cost implications of renewables vis-à-vis the rate of recouping investments to prolong the life span of licenses to attract investments. Besides, the establishment of the RE Fund under Section 32 together with the transparent accessibility regime the Act created, among other measures, is sufficient support scheme for the promotion of renewables in the system. Additionally, under Sections 9 to 25, the Act provides broad policy guidelines on the procedures for entering the energy market with renewables. The Act gives the PURC the responsibility to set the Feed-In-Tariff (FIT) as the pricing mechanism for Renewable Energy Technology in Ghana.

The REMP-CU shall be responsible for the overall procurement and fiscal management, coordination with key REMP Components Implementation Entities and Beneficiaries (CIEB-Public and private sector actors implementing aspects and or whose actions are aligned with the REMP) and reporting obligation. The Ministry of Energy will from time-to-time designate relevant entities to implement key components of the REMP. A National Steering Committee (NSC) made up of experts drawn from all relevant institutions will be established to provide overall guidance to the REMP and will among other responsibilities review progress made at the end of each cycle. Members of the NSC will serve for not more than two terms aligned with the REMP implementation cycles. The NSC will hold quarterly meetings and as and when necessary. The REMP-CU will be staffed with competent personnel. The REMP-CU arrangements, assets and liabilities shall be given to the Renewable Energy Authority when it is established and operational.

The Ghana Atomic Energy Commission Act (204) of 1963 was established by an Act of Parliament Act 204 of 1963, as the sole Agency in Ghana responsible for all matters relating to peaceful uses of atomic energy. Act 204 was amended in 1993 by PNDC Law 308 mainly to enable it to create other institutes under the Commission. This amendment resulted in the creation of two other Institutes in addition to the National Nuclear Research Institute (NNRI) formerly Kwame Nkrumah Nuclear Research Institute (KNNRI). The two Institutes are the Radiation Protection Institute and the Biotechnology and Nuclear Agriculture Research Institute (BNARI). The founding Act 204 of 1963 has been superseded by Act 588 of 2000 to make provision for GAEC to undertake commercialisation of its research and development results. The objective of energy,

[9] Established under the Public Utilities Regulatory Commission Act, 1997 (Act 538).

industrial and infrastructure development areas is to minimize greenhouse gas emissions is to encourage the use of efficient energy and cleaner energy technologies that contribute towards economic development, as well as result in green development and optimal national emission rates. Key policy interventions to address the objective and which encourage green industry/Eco-innovation include support for research, development and transfer of low emission technology such as natural gas combined cycle power generation, natural gas distribution system, and mini and small hydroelectricity projects; promotion of energy efficiency and management activities that include new and innovative energy efficiency methodologies and techniques in various sectors, especially power generation, oil and gas production, transport, biomass, industry, and waste; promotion of the use of cleaner and more efficient energy sources and production methods that minimize resulting emissions and pollution; creation of an enabling environment, including incentives and financing mechanisms that encourage and support the use of renewable sources of energy; establishment of effective mechanisms for reducing the volume of wastes, and for controlled and safe disposal of unavoidable wastes; establishment of sustainable recycling and waste management technologies that generate energy (e.g., biomass energy, biogas, methane, etc.) and reduce emissions from solid and liquid wastes, especially in urban areas; and support for public awareness of energy efficiency and of renewable energy use. The institutional framework for the sector is as provided in Table 12 below.

Table 12: Eco-innovation relevant Institutions and actors in the Energy Sector-Ghana

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Energy	The function of the ministry is to improve the distribution of electricity across the country, especially to communities and towns in rural Ghana. The ministry seeks to encourage the participation of the private sector in the development of energy infrastructure and secure future energy supply.
Energy Commission	• To serve as the Government's energy policy adviser by making national energy policy recommendations to the Minister of Energy. • To formulate national policies for the development and utilization of indigenous energy resources, in particular, renewable energy: solar, wind and biomass; • Prepare, review and update periodically indicative national plans to ensure that all reasonable demands for energy are met; • To prescribe by legislative instruments standards of performance and technical and operational rules of practice for the supply, distribution, sale of electricity and natural gas to consumers by public utilities; • To enforce the provision of such legislative instruments uniformly throughout the country; • To promote competition in the supply, marketing and sale of renewable energy products and other forms of energy; • To promote energy efficiency and productive uses of electricity, natural gas; and petroleum products.

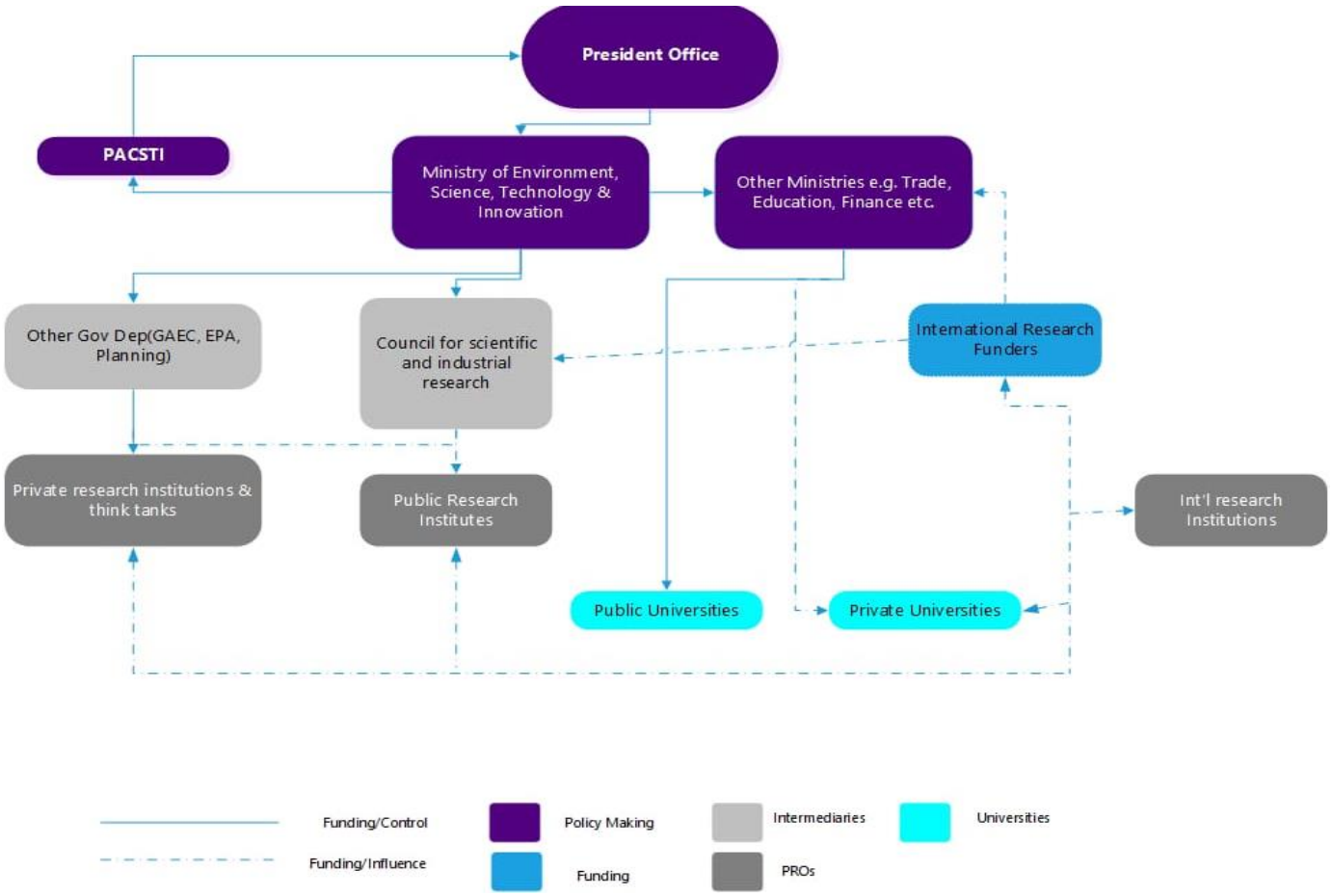
	• To license public utilities for the transmission, wholesale supply, distribution and sale of electricity and natural gas; and • To secure a comprehensive database for national decision making for the efficient development and utilization of energy resource
The Ghana Atomic Energy Commission	The functions of the Commission as prescribed in Act 588 of 2000 are: • To make proposals to the Government for Legislation in the field of nuclear radiation and radioactive waste management. • To advise the Government on questions relating to nuclear energy, science and technology. • To establish, for research and in furtherance of its functions, Institutes of the Commission and to exercise control over the boards of management of the Institute. • To encourage and promote the commercialisation of research and development results through its Institutes. • To supervise the carrying out of all requirements designed to secure the safety and health of radiation workers and the environment. • To engage in research and development activities, as well as in the publication and dissemination of research findings and other useful technical information. • To oversee and facilitate the development of human resources in the fields of nuclear science and technology, and to promote the training of scientific, technical and non-scientific personnel of the Commission. • To maintain relations with the International Atomic Energy Agency and other similar international and national organisations on matters of research and development of nuclear energy and nuclear technology. • To collaborate with Universities and Research Institutes to research matters connected with the peaceful uses of nuclear energy and technology.
National Steering Committee (NSC)	The NSC made up of experts drawn from all relevant institutions will be established to provide overall guidance to the REMP and will among other responsibilities review progress made at the end of each cycle. Members of the NSC will serve for not more than two terms aligned with the REMP implementation cycles. The NSC will hold quarterly meetings and as and when necessary.
The Public Utilities Regulatory Commission (PURC)	PURC was set up by an Act of Parliament, Act 1997, and (Act 538) to regulate the provision of utility services in Ghana. The PURC is an independent regulator that currently regulates water, electricity and natural gas. The Commission under its mandate has the responsibility to set utility tariffs in Ghana.

REMP Coordinating Unit (REMP-CU)	The REMP-CU shall be responsible for the overall procurement and fiscal management, coordination with key REMP Components Implementation Entities and Beneficiaries (CIEB) and reporting obligation. The Ministry of Energy will from time-to-time designate relevant entities to implement key components of the REMP.
Components Implementation Entities and Beneficiaries (CIEB)	Aspects of the REMP shall be implemented by the CIEB. The CIEBs shall include but not limited to the following; Energy Commission, Public Utilities Regulatory Commission, National Petroleum Authority, Forestry Commission, Ministry of Food & Agriculture, Ghana Irrigation Development Authority, Ghana Grid Company, Training & Research Institutions, Electricity Distribution Companies, Public Electricity Generation Companies, Renewable Energy Private Sector Companies, Civil Society Organizations, etc. Their roles and responsibilities shall be determined and defined by the REMP-CU in consultation with the NSC and aligned with their statutory mandates as defined in the Renewable Energy Act, 2011 (Act 832).

3.3.7 Eco-innovation related Policies and Frameworks in the Science, Technology and Innovation (STI) sector- Ghana

Ghana's attainment of middle-income status with per capita GDP has more than doubled from US$400 per capita in the 90s to above US$1,000 currently. More importantly, the achievement sets the tone for the ambitious goal of attaining a per capita GDP of US$3,000 by 2030 as announced by the Government of Ghana. However, such national ambitions can only be attained on the wheels of a solid base of STI. There is still the fundamental problem of catching up technologically with the more advanced countries, but nowadays the emphasis is more on the essential driver and sustainer of socio-economic transformation in the world – innovation. Innovation ensures the use of knowledge to bring about scientific and technological applications which are new in the context of usage even though they may not be new in other parts of the world. In every sector of the national economy, there are specific problems to which innovation could provide good solutions. It is thus a pivot of economic growth and must be at the centre of Ghana's ability to attain its national economic vision.

Ever Since 2000, Ghana has had two S&T policies. Unlike the 2000 S&T Policy document, the 2009 STI Policy had innovation as a critical driver for socio-economic and sustainable development. The policy document had a 5-year ***National STI Development Plan (STIDeP)*** that spelt out 17 programmes and 84 projects to be implemented. With such an articulated policy and action plan, the biggest challenge was the implementation process. Key challenges were lack of institutional framework for implementation, monitoring and evaluation of the STIDeP, lack of funding for implementing projects and activities, and lack of commitment from key institutions and agencies who were to lead or collaborate in implementing programmes and projects, amongst others. In 2017, the Ministry of Environment, Science, Technology, and Innovation (MESTI) reviewed the 2010 STI policy to develop a new one, which is aimed at bridging the gap between STI policies on the one hand and sectoral policies and development agenda on the other.



Source: DFID, (2019a)

Figure 4: Stakeholder relationships in Ghana's research system

The National Science, Technology and Innovation Policy of 2017 aims in broad terms, to provide a framework for stimulating innovation in the economy and the society (GoG, 2017). The MESTI has the mandate to promote science and technology application in the country and to create the conditions and enabling environment for innovations to occur. The policy places emphases on the environment as a source of natural resources, and the fact that its deterioration can be detrimental. Some of the activities and programmes to apply STI in the management of the environment to maintain and enhance quality and sustainability and to integrate environmental concerns in all development policies include the following: (1) integrate environmental concerns in all development policies and ensure public understanding of the scientific basis of their actions on the environment; (2) encourage and support science and technology interventions that promote sustainable environmental conservation and management; (3) strengthen research and development activities that would promote sustainable development especially of ecosystems and ecological processes; (4) develop the STI capacity to monitor, predict and mitigate the adverse effects of natural phenomena such as earthquakes, floods, droughts, desertification and bushfires; (5) develop an efficient integrated waste management system for using the principle of waste as a resource and (6) promote the use of clean technologies in production systems. Figure 4 above summarizes the stakeholder relationships in the Research system in Ghana.

R&D in Ghana is largely funded by the government. The government has annual budgetary allocations for MOE, MESTI, and other line ministries, through which most of the public R&D is funded. This amounts to at least 70% of the funding for public R&D institutions. The country does not have a specific institution dedicated to financing science, technology and innovation or R&D programmes. Some of the public R&D institutions rely on grants from international donors in order to conduct R&D activities. Often such activities are project-based or project-oriented and the funding is short-term in nature. Ghana's research and innovation system is characterised predominantly by publicly-funded organisations. The main research policymakers are MESTI and the Ministry of Education, that are respectively responsible for STI policy formulation and STI policy concerning education. Government directorates are responsible for STI policy formulation and the coordination of research activities and support, alongside advisory committees and research organisations. The CSIR and the Ghana Atomic Energy Commission within MESTI for example coordinate 13 and six research institutes respectively. These research bodies significantly support the Ghanaian Government in the development of STI policies in line with national development. They play a significant role in encouraging scientific and industrial research in areas of national priority such as agriculture, health and technology. The Presidential Advisory Council on Science, Technology and Innovation (PACSTI) monitors and coordinates the implementation of STI policies.

Examples of Eco-innovative initiatives in Ghana especially on the energy sector are provided in Box 4 below.

Box 4: Partnerships in Eco-Innovation in Energy Sector in Ghana

NASAM Brand Enterprises uses galvanized clay to produce clean and effective stove in order to preserve the environment and to support green economy. The company recently emerged the overall winner for 2018 National Best Improved Woodstove for Household Challenge at an award scheme organized by SNV, Netherlands Development Organization to recognize the efforts of entrepreneurs in the industry.

The Ghana Alliance for Clean Cookstoves and Fuels (GHACCO) has been awarded a grant from the Business Sector Advocacy Challenge Fund (BUSAC) to conduct advocacy on Bioenergy Policy in Ghana. The BUSAC Fund is a multi-donor platform to enhance the business environment of private sector actors through advocacy and capacity building with support from the Danish International Development Agency (Danida), European Union (EU) and Government of Ghana (GoG). A robust Bioenergy Policy will facilitate the development of the biomass sector in Ghana and support the promotion of clean cooking technology solutions to help the government achieve its National Intended Contributions to Climate Change whiles improving the socio-economic, energy access and environmental goals in Ghana.

According to GHACCO, the Ghana Bioenergy Policy is still at the draft stage, though over 73 percent of rural households depend on solid fuels for cooking. The project seeks to train members on advocacy, conduct a study on bioenergy in Ghana, conduct sensitization of members, engage stakeholders and government on advocacy on bioenergy and develop actions to enhance the promotion of bioenergy in Ghana. This will be done in partnership with institutions such as the Ministry of Energy, Ministry of Environment Science and Technology and Innovation, Ministry of Agriculture and the Energy Commission and the Environment Protection Agency (EPA).

Ghana Climate Innovation Centre (GCIC) has built local institutional capacity to establish the Centre as the leading business incubator in providing support for Ghanaian entrepreneurs & start-ups involved in developing profitable & locally appropriate solutions to climate change mitigation & adaptation. NASAM and GCIC has been working together to achieve the green economy in Ghana.

https://incubator.ghanacic.org/; https://bioenergyinternational.com/policy/ghacco-busac-promote-advocacy-bioenergy-policy-ghana

Table 13 provides the key institutions involved in STI in Ghana and their roles.

Table 13: Eco-innovation relevant Institutions and actors in the Science Technology and Innovation Sector-Ghana

Name of institution/ Actor	Roles played in Eco-innovation
Ministry of Environment, Science, Technology and Innovation (MESTI)	• Provide leadership and guidance for Environment, Science, Technology and Innovation within the broad sector of the economy through sound policy formulation and implementation; • Ensure the establishment of the regulatory framework and setting of standards to govern the activities of science and technology and the management of the environment for sustainable development;

	• Promote activities needed to underpin the standards and policies required for planning and implementation of sound scientific and technological development activities; • Ensure the coordination, supervision, monitoring and evaluation of activities of Environment, Science, Technology and Innovation while fulfilling national benefits-sharing commitments; • Set out the parameters required for programmes on the environment, science, technology and human settlement in consultation with the National Development Planning Commission (NDPC) in guiding the Districts Assemblies as the planning authorities at the local level; • Analyse and coordinate all planned programmes as well as budgets in the environment, science, technology and innovation sector of the economy for purposes of achieving a single integrated management system; • Initiate, simulate and coordinate research including the continuous development and review of policies, laws, rules and regulations in the environment, science, technology and innovation sector of the economy; • Ensure effective environmental management and governance.
Council for Scientific and Industrial Research (CSIR)	The specific functions of the CSIR are: • To encourage in the national interest, scientific and industrial research of importance for the development of agriculture, health, medicine, environment, technology and other service sectors of the economy; • To co-ordinate all aspects of scientific research nationwide and ensure that the Council, the research institutes of the Council and other organizations engaged in research in Ghana coordinate and cooperate in their research efforts; • To advise the sector Minister (MESTI) on scientific and technological advances likely to be of importance to national development; • To assist the government in the formulation of STI policies for the realization of its development objectives; • To encourage coordinated employment of scientific research for the management, utilization and conservation of the natural resources of Ghana for national development; • To commercialize appropriate technologies in partnership with the private sector and other stakeholders; and • To develop, package and disseminate STI information.
The Presidential Advisory Council on Science, Technology and Innovation (PACSTI)	Monitors and coordinates the implementation of STI policies.

The private sector	Encouraged to contribute to the financing of STI application and development in Ghana through various schemes. Initiation of Public-Private Partnerships (PPPs) in the application and development of STI. The private sector will be engaged as interested partners in STI programmes. This is particularly feasible in the commercialization of R&D activities.
Ministry of Lands and Natural Resources	• To ensure sustainable natural resource use through Good Governance • To accelerate reafforestation and plantation establishment for environmental and watershed management and job creation • To maximize national revenue and benefits to rural communities from mineral resource extraction whilst ensuring good environmental stewardship. • To reduce the loss of biodiversity • Maintain and enhance the protected area system. • To strengthen the legal framework on protected areas Reverse forest and land degradation • To encourage appropriate land use and management • To enhance community participation in environmental and natural resources management by awareness creation.

3.3.8 Eco-innovation related Policies and Frameworks in the Transport Sector-Ghana

In Ghana, about 8.6% of its budget is invested into transportation and about 99% of this investment is dedicated to the road sub-sector, confirming the over-reliance on the sector. In other words, large amounts of resources are spent on costly interventions, such as flyovers, ring roads, and urban highways, making driving even more attractive, and hence creating additional traffic. Auto vehicle emissions are a major challenge for ambient air pollution control in Ghana. Major auto emissions, particulate matter, are critical road transport emissions that threaten human health and the environment but are often excluded from policy discussions. In Ghana, vehicle acquisition schemes are not environmentally friendly and current national policies have alienated the monitoring of airborne emissions from the transport sector. This calls for the design and implementation of green transport and fuel economy options. Ghana has a National Transport Policy that recognizes the challenges of environmental pollution due to vehicular emissions and uneconomic fuel consumption. There are green fuel policy proposals and a vehicle testing and licensing regime that is largely driven by mechanical and electrical functionality. Auto-vehicle emissions performance standards have not been developed and technical capacity for emissions testing is lacking.

The National Transport Policy (NTP) of 2008: The Ministry of Roads and Highways and the Ministry of Transport have adopted a sector approach with the formulation of the National Transport Policy (NTP) (currently under review) as the guide to development and improvement of transportation in general. The vision of the transport sector, as stated in the NTP, is to provide an integrated, efficient, cost-effective and sustainable transportation system. The NTP defined the strategic goals for improving the performance of the sector. Among them to establish a Transportation Hub for the West African Sub-Region; Create a sustainable, accessible, affordable,

reliable, effective, efficient, safe and secure transport system that meets user needs and world classed; Integrate land use, transport planning, development planning and service provision; Create a vibrant investment and performance-based management environment that maximizes benefits for public and private sector investors; Develop and implement a comprehensive and integrated Policy, Governance and Institutional Framework; relevant to this study, ensure Sustainable Development in the Transport sector as well as develop adequate Human Resources and apply new efficient Technologies. Table 14 provides the major institutions implementing Transport sector policies in Ghana and their roles.

Table 14: Eco-innovation relevant Institutions and actors in the Transport sector - Ghana

Name of institution/actor	Roles they play in support of Eco-innovation
The Ministry of Roads & Highways (MRH)	Has overall responsibility for the road infrastructure sector with the mandate of policy formulation, sector coordination and oversight, and sector performance monitoring and evaluation of the following broad areas: Road infrastructure development and maintenance; and Road maintenance financing. The Departments, Agencies and Units that operate under the direct ambit of the MRH and the functions they perform are listed below.
Ghana Highway Authority (GHA)	Responsible for the administration, planning, control, development and maintenance of trunk roads and related facilities in the country.
Department of Feeder Roads (DFR)	Responsible for the administration, planning, control, development and maintenance of feeder roads and related facilities in the country.
Department of Urban Roads (DUR)	Responsible for the administration, planning, control, development and maintenance of urban roads and related facilities in the country.
The Ghana Road Fund Secretariat (GRFS)	The Road Fund Secretariat was established by Act 536 (1997) to finance the following activities: • Routine and Periodic Maintenance of road and related facilities. • Upgrading and rehabilitation of Roads. • Road Safety Activities. • Selected Road Safety projects; and • Such other relevant matters may be determined by the Board.
Environmental Protection Agency (EPA)	The EPA has the mandate to decide on project screening, guide the conduct of any EA studies and grant environmental approval for road sector projects to commence. Its mandate also covers monitoring of the implementation phase of road projects to ensure compliance with approval conditions, mitigation measures, and other environmental commitments and quality standards.

3.3.9 What works, what doesn't work and why in Ghana

Several initiatives and projects aimed at developing infrastructure and institutions for Eco-innovation related development in Ghana have been implemented with some level of success attributed to the various approaches used. These approaches have been influenced by various existing or enacted policies and practices. This section will highlight some of these initiatives and how successful or unsuccessful they have been and why.

3.3.9.1 What works and why

a) The Structural Adjustment Programme

Supporting policies and Strategies: Ghana Vision 2020, Industrial Designs Act of 2003, Patent Regulations of 1996, Trade Marks Act of 2004, the Ghana Trade Policy (2005). The Ghana - Vision 2020, the National Trade Policy (NTP) of 2005, the National Policy on Public-Private Partnership of 2011, the National Science, Technology and Innovation Development Programme of Ghana (STIDeP) 2011-2015, Ghana ICT for Accelerated Development Policy of 2003, Ghana Industrial Policy of 2011 and the Ghana Shared Growth and Development Agenda II (2014-2017).

Description and impact: The development of the private sector has been recognized as the means to accelerate the rapid industrialization desired by developing countries. In this light, Ghana embarked on the Structural Adjustment Programme in the late 1980s which gave prominence to the private sector as an engine of growth in the country. Since then, other policies and programmes have been instituted by successive governments to make the private sector flourish and drive the country's economic prosperity. Direct and indirect support and incentives to Ghana NIS Actors is conditional on the engagement of Medium- and High-Tech Industry with Knowledge-Based Institutions and vice versa; triangulation between non-Government Actors with respect to human capital mobility, intermediation, and intellectual property rights in relation to Government contracts and public procurement terms and conditions. These have thickened and intensified inter- and intra-Actor linkages and reduced asymmetries in the NIS. In terms of job creation, the private sector has lived up to expectations, as it accounts for about 87.7% of jobs in Ghana's industry.

Reasons for success:

- Government's commitment and efforts to promote private sector development,
- recognition by the government to encourage commercial use of R&D
- Putting in place incentives to encourage participation and investments by the private sector

b) Joint Collaboration among MESTI and MDAs in Tackling Environmental Issues

Supporting policies and strategies: Transformative Innovation Policy (TIP) of 2018, the National Science, Technology and Innovation Policy of 2017, the Environmental Protection Agency Act 490 of 1994 and the National Environmental Policy of 2012.

Description and impact: The MESTI in collaboration with other key Ministries, Agencies and the private sector in Ghana is implementing several policy initiatives aimed at achieving the "*Ghana Beyond Aid Agenda*." Ghana is currently participating in the TIP initiative through the innovative policy for waste management which is a major challenge in Ghana. Various governments have developed several policies and strategies aimed at addressing waste disposal and management in the country. The President, in his quest to solve the waste management issue in the country, established a Ministry of Sanitation and has tasked various related ministries such as MESTI, the

Ministry of Local Government and other state agencies to work together to develop policies and programmes that will aggressively tackle the menace of waste in the country. In light of this, several policies have been developed and some being developed for waste management. Some of these policies include the Environment Policy, the Plastic waste policy, the E-waste Policy and law, and the Sanitation Policy, to name a few.

The EPA has been working with other ministries such as the ministry of agriculture in implementing national and regional programmes. The West Africa Agricultural Productivity Program (WAAPP)[10] for instance led to the development of various technologies in the sector. WAAPP was a two-phase, 10-year program, each of 5-year duration. The first phase of WAAPP involved three countries – Ghana, Mali and Senegal. The priority commodities for the WAAPP which have been derived from a study carried out by the International Food Policy Research Institute (IFPRI) and West and Central Africa Council for Agricultural Research and Development (WECARD/CORAF) in 2006, identified roots and tubers, livestock, rice, cereals among other as the commodities that make the greater contribution to the region's agricultural growth and productions' benefit, from research and development. Ghana has developed over 30 agricultural technologies under this program. WAAPP's development objective is to generate and disseminate improved technologies in the country's top priority commodities in root and tuber crops, specifically, cassava, yam, sweet potato and cocoyam. WAAPP Ghana has the CSIR as its implementing agency. Diverse crop varieties and agricultural technologies have been developed.

Also critical is Ghana joining the Transformative Innovation Policy (TIP) Africa Exploratory Hub in 2018 with a special focus on the case study of the E-waste management system in Ghana. The Transformative Innovation Policy Consortium (TIPC) is a multi-country initiative for STI policies that promote the transformation of systems and societies to foster environmental sustainability, achieve more equitable income distribution and help address social challenges including gender, inequality, and exclusion. In Ghana, the TIP project was implemented by Council for Scientific and Industrial Research (CSIR)-Science and Technology Policy Research Institute (STEPRI) in collaboration with the MESTI and the University of Ghana (UG) with technical support from the Science Policy Research Unit (SPRU) at the University of Sussex, UK.

Reasons for success:

- Close collaboration amongst the lead agencies
- The institutional setup especially in the Environment & Natural Resources, the STI and Education sectors are very elaborately knitted and work very well in research and innovation development.
- The decision by the government to domicile the STI issues together with Environment under MESTI has worked to the advantage in advocating for proactively seeking for eco-innovativeness in all innovations that are sought.

c) Establishment Technology Development and Transfer Center (TDTC)

Supporting policies, strategies and plans: The National Science, Technology and Innovation Policy of 2017 and Transformative Innovation Policy (TIP) of 2018.

10

Description and impact: The Technology Development and Transfer Center (TDTC) aims at developing a structured mechanism that facilitates the effective transfer of CSIR technologies to the private sector. The structured system ensures the generation of ideas from the private sector for the development of appropriate innovations and technologies that provide business solutions. The project has led to the development of the private sector; developed and implemented a structured model for engaging them in partnerships for technology development and transfer as well as the development of capacity on technology transfer that has enhanced knowledge and skills of the TDTC staff, the researchers and other relevant staff whilst also addressing the technology adoption capacity needs of the private sector entrepreneurs. The Center also created a system or platform for intensive research-industry interaction, also did technology profiling of all marketable technologies developed by the participating CSIR Institutes. It also created the TDTC Website and helped in the selection and funding of 20 market-ready CSIR technologies through a competitive Grant Award Scheme. The TDTC has been providing support to UG faculty to protect and promote their research outputs through creating awareness on IP, IP protection among other related support. It has also been influential in developing industry collaborations including collaborations with the Association of Ghana Industries (AGI) and the Private Enterprise Federation hence strengthening the link between the actors in the technology research space.

Reasons for Success:

- Conducting capacity needs assessment and baseline survey before implementation of the project.
- Training modules for training were developed and capacity Building of Project Core Staff, Focal Persons and Research Scientists were conducted.
- The organisation of sensitization workshops and training.

d) Operationalisation of the Green Economy (GE) Transition in Africa Project

Supporting policies, strategies and plans: The National Climate Change Policy of 2013, National Environmental Policy of 2012, the National Climate Change Adaptation Strategy of 2012 and the Renewable Energy Act of 2011.

Description and impact: The objective of operationalising the Green Economy (GE) transition in Africa project was to complement national efforts to translate GE strategies from the national to the sub-national (District) level. To achieve this objective, the project was piloted in three districts: Tolon District (TDA), Kumasi Metropolitan (KMA) & Tema Metropolitan (TMA). This project involved the adoption of the UNEP GE Toolbox and the step-by-step guide. The Integrated Green Economy Implementation Plan (IGEIP) was then developed for the 3 piloted districts based on the step-by-step guide. The IGEIP to NDPC district planning guidelines were aligned to ensure uniformity and consistency. This was then replicated in 2018 in other districts following the successful mainstreaming of the step-by-step guide into National Development Planning Commission (NDPC) planning guidelines which have since been used in the preparation of MMDAs Medium Term Development Plans (2018-2021). The need to replicate the GE achievements in other districts led to the development of a national GE replication strategy based on the lessons learnt and best practices from the pilots. This project created the needed awareness and provided the framework for mainstreaming Green Economy issues in the medium-term development plans of the MMDAs in Ghana. This development was based on the available human and natural resources in the respective districts. It is expected that the implementation of the

replication strategy will lead to a Greener Economy for Ghana and also contribute to the achievement of the Sustainable Development Goals (SDGs) by the year 2030.

Reason for Success:

- Multi-agency support and participation
- Extensive preparation -Research, piloting and strategizing
- International support and interest

e) Rain Water Harvesting (RWH) for Resilience to Climate Change Impact on Water Availability in Ghana

Supporting policies and strategies: Ghana Poverty Reduction Strategy (GPRS) II, the National Science, Technology and Innovation Policy of 2017, Transformative Innovation Policy of 2018, the National Environmental Policy of 2012, the Ghana National Climate Change Policy of 2013, the National Climate Change Adaptation Strategy of 2012, the Environmental Sanitation Policy of 2010, the National Land Policy of 1999 as Amended in 2002 and the National Water Policy of 2007.

Description and impact: Ghana, like other nations, is prone to the effects of climate change. The climate change effects on the quality and quantity of fresh water in Ghana cannot be over-emphasized and the result of this is that most households and institutions in Ghana have no access to portable water. There is an urgent need for an alternative source of water supply to meet the shortfall in the current water supply. It is against this background that SINTEF, a leading research institution in Norway in collaboration with the WRI and STEPRI both of the CSIR initiated a research project dubbed "Rain Water Harvesting (RWH) resilience to climate change impact on water availability in Ghana. The objectives of the project are to increase resilience to climate change impact on water availability in Ghana; facilitate business development in RWH technology; improve urban livelihoods; increase water availability in selected household and schools; make affordable, appropriate and innovative RWH systems more available in Ghana; and strengthen human and institutional capacities in RWH. The project accomplished the following:

- Organized four training workshops for thirty artisans (masons, carpenters, plumbers and electricians) mainly on roof assessment, installation of the systems, as well as business development in RWH. Topics covered include costing/budgeting, business opportunity identification, registration of business, customer relation and marketing, financial options, cluster formation etc.
- Organization of stakeholders' workshops where all the key stakeholders in the water sector were brought together and preliminary findings from the project have been presented for their input. Meetings and seminars have also been organized as a means of dialogue with the stakeholders who mainly include members from the Ministry of Water Resources Works and Housing (MWRWH), Community Water and Sanitation Agency (CWSA), Water Resources Commission (WRC), Ghana Real Estate Development Association (GREDA), National Development Planning Commission, the media etc.
- Completion of installation of the RWH systems in fourteen (14) houses in Accra;
- Socio-economic monitoring and evaluation of beneficiaries of the RWH systems
- Monitoring of quantity and quality of harvested water; and

- Promotion of the RWH technology in Ghana through outreach events at a Shopping mall in Accra, Rainwater Harvesting (RWH) forum and seminars with key stakeholders including policymakers, technocrats, estate developers among others.

Reason for success:

- A conducive enabling policy environment and institutional arrangements,
- A strong community participation component as well as strong government support through the lead agencies.

f) Implementation of Energy Policies and Projects

Supporting policies and strategies: The Renewable Energy Master Plan (REMP) of 2019, Renewable Energy Act of 2011 (832), National Energy Policy of 2009, National Energy Strategy of 2010, the Strategic National Energy Plan (SNEP) 2006-2020 and Ghana Poverty Reduction Strategy (GPRS) II.

Description and impact: The REMP of 2019 has been developed to provide an investment-focused framework for the promotion and development of the country's rich renewable energy resources for sustainable economic growth, contribute to improved social life and reduce adverse climate change effects. The REMP aims to achieve the following by 2030: increase the proportion of renewable energy in the national energy generation mix from 42.5 MW in 2015 to 1363.63 MW (with grid-connected systems totalling 1094.63 MW); reduce the dependence on biomass as the main fuel for thermal energy applications; provide renewable energy-based decentralised electrification options in 1,000 off-grid communities; promote local content and local participation in the renewable energy industry. The REMP also prescribes action plans for all Renewable Energy Technologies (RETs). For each of the RET areas (solar, wind, hydro, biomass, etc.), the action plan analysed the resource availability, opportunities in developing the resource and recommended interventions for their promotion and development. Further details and actions were provided for each of the technologies/ interventions under each resource with specific considerations given to the challenges and strategies to promote it. The renewable energy target of 10% by the year 2020 was not achieved as most of the policy instruments in the Renewable Energy Act could not be fully operationalised to boost renewable energy investment. The government has, therefore, extended the 10% target to the year 2030 and has come up with Renewable Energy Master Plan with estimated investments required to achieve the target. There was an increase in the National electrification in the rural areas and procurement of 275 solar streetlights with funding from the Chinese government in 2013 to support the initiative. In addition, about 12,105 solar lanterns have been distributed to 44 districts under the kerosene lantern replacement programme and about 2,400 old and inefficient refrigerators have been replaced with new and efficient ones. There has also been a major energy infrastructure improvement such as the RE Grid codes for transmission and distribution networks, Net-Metering Code for connecting RE systems to distribution networks and Feed-in-Tariffs have been developed; licensing has been granted to both private and public institutions for the development of RETs; and institutional capacity building for testing RETs such as Solar PVs and efficient cookstoves have also been achieved through technical support from UNDP-Ghana. Despite these gains in enhancing RETs development, there was also a long delay in setting up the RE fund to finance RET developments and the Net-Metering system.

Reasons for success:

- Diversification of electricity supplies in ways that would improve access to electricity in particular and safeguard energy security in general, the Act not only envisages a framework to support the development and utilization of these renewable energy sources but also the creation of an enabling environment to attract investment in those sources.
- A well-integrated long-term scheme that guarantees project bankability for private investors in the deployment of renewables.

3.3.9.2 What doesn't work and why

Various factors have contributed to the derailed development of Eco-innovation related initiatives and projects. These factors are either systematic flaws in policy or are related to implementation strategy problems. They include:

- *Lack of sufficient funds to support STI:* The STI system is far too supply-driven, owing to its overreliance on the public budget and external sources of funding including donor-sponsored projects based on donor agendas. Funding allocations are determined by the Government and often do not relate to the priorities of the providers of science and technology services (i.e. the research institutes and universities) and much less still to the end-users of technology and research, such as the private sector, farmers, and informal enterprises. The result is a system not subject to competitive pressures to ensure quality, and not adequately focused on Ghana's own economic and social objectives. The country does not have an adequate mechanism to fund innovation, technological development and research on a competitive basis. Ghana does not have the equivalent of South Africa's National Research Foundation (NRF) and its Innovation Fund to oversee the review and implementation of competitive research and innovation funding programmes. Furthermore, there is no horizontal coordination and no clear regime for setting research priorities.

- *Minimal private sector participation*- The private sector has not been responding to the existing incentives to adopt new technologies, innovate, and raise productivity. The Government could improve fiscal and legal incentives for local entrepreneurship and promote innovation in private enterprises. Local private-sector firms are not attuned to procuring and/or investing in innovations to improve their economic productivity. The adoption and adaptation of existing technology by firms should be encouraged, as the most logical focus for Ghana's technology and innovation efforts. Previously, Ghana was focusing its attention on promoting private-sector development and attracting FDI. There is now a need to focus on promoting technological innovation in and by the private sector.

- *The STI system is stretched thin and overburdened in relation to the level of resources available*. This leaves many of the country's important STI institutions unable to effectively carry out their mandates. The level of overall expenditure is not enough to support high-quality STI activities across the existing system. This does not necessarily mean that more resources are required, or indeed, would fix the problems. Rather, the Government must determine which areas and activities of the STI system are necessary and important, and must properly fund them to allow them to fulfil their mandates. Any proposed new resources should be accompanied by substantial improvements in efficiency and incentives to turn new expenditures into development gains.

- *Institutions of education and training are not producing enough graduates with the required skills to spur technological innovation for economic growth.* This is a major barrier to improving the country's technological performance and to growing a national system of innovation. This has been recognized by the Government, and various reforms of the education and training system are being introduced. Measures aimed at improving tertiary education should be part and parcel of overall national efforts to fight poverty, grow the economy, promote human development and increase economic competitiveness. Overall, Ghana's educational system is not well aligned to its economic and industrial development aspirations. Poor research management means that opportunities to secure what funding is available for conducting research and purchasing equipment are frequently missed. The scientific and technical knowledge that is generated by public R&D institutes is not turned into products and services because of a lack of entrepreneurial culture and few incentives to link with the private sector.

3.4 Eco-innovation Related Policies and Institutions in Kenya

3.4.1 Overview

Kenya has made significant political, structural and economic reforms that have largely driven sustained economic growth, social development and political gains over the past decade. However, its key development challenges still include poverty, inequality, climate change, continued weak private sector investment and the vulnerability of the economy to internal and external shocks. Kenya ushered in a new political and economic governance system with the passage of a new constitution in 2010 that introduced a bicameral legislative house, devolved county government, a constitutionally tenured judiciary and electoral body. In 2019, Kenya's economic growth averaged 5.7%, placing Kenya as one of the fastest-growing economies in sub-Saharan Africa. The recent economic expansion has been boosted by a stable macroeconomic environment, positive investor confidence and a resilient services sector. Kenya's economy is being hit hard through supply and demand shocks on external and domestic fronts, interrupting its recent broad-based growth path. Apart from the COVID-19 (coronavirus) pandemic, the locust attack which started in early 2020, has affected many parts of Kenya especially the North East. It has harmed the food security and growth of the agriculture sector in the country. Real gross domestic product (GDP) growth is projected to decelerate from an annual average of 5.7% (2015-2019) to 1.5% in 2020[11].

Kenya like other countries in the world has been implementing sustainable development and embracing eco-friendly technologies. To enhance efficiency in the use of natural resources and energy, the industrial sector has embraced cleaner production technologies through technical assistance by the Kenya National Cleaner Production Centre. The Centre has built the capacity of industries in improving efficiency in the status of production systems/ equipment to reduce wastage of raw materials and energy aimed at minimizing waste generation at source. In Kenya, green initiatives are spread across public and private sectors of the economy. It is therefore important that green economy be embraced at all levels aimed at reducing individual carbon footprints in order to uphold sustainability.

[11] https://www.worldbank.org/en/country/kenya/overview

Eco-innovation in Kenya is a fairly new concept. However, it can be related to optimal exploitation and utilization of natural resources for sustainable development. Additionally, it entails the use of technologies to ensure long-term use and sustainability of existing resources while reducing the negative impacts on the environment. In response to many pressing economic, environmental and social concerns, such as increasing rural to urban migration, need for job creation and environmental degradation, Kenya has established some policies and strategic plans for a green economy such as ***the Green Economy Strategy and Implementation Plan (GESIP) 2014-2030.*** For efficient use of the available natural resources, different sectors have different guidelines and policies that are aimed at ensuring sustainability. The overall national development objective of the government is anchored on accelerating economic growth and increasing productivity across all sectors, ensuring equitable distribution of national revenues, poverty alleviation through provision of basic needs to the citizens, enhanced agricultural production, promoting industrialization and employment creation.

Kenya Vision 2030 is the country's new development blueprint covering the years 2008-2030. It aims to transform the country into a middle-income economy by 2030 (GoK, 2008). It is implemented through successive five-year Medium-Term Plans. The vision directs the agricultural sector to be innovative, modern and commercially oriented. This vision requires the country to be clean, safe and environmentally sustainable, thus supporting green growth. It also identifies flagship projects in water catchment, investment in renewable sources of energy and specific programs for agricultural development.

3.4.2 Enablers and/or constrainers of Eco-innovation in Kenya

Kenya has made a commendable milestone in the move towards green growth and sustainable development. This can be attributed to various factors such as maintaining a stable macroeconomic environment, which favours both private and public investments. In line with Kenya Vision 2030 (GoK, 2008), the government has made different policies that enhance the macroeconomic resilience to external shocks, thus providing a good basis for Eco-innovation. Specific policies and institutional frameworks have also been instituted that promote low carbon emission, climate change development and environmental conservation that minimize pollution. Moreover, the use of efficient and eco-friendly technologies has been advocated like the use of star-marked light bulbs that are more efficient thus minimizing power usage. Besides, eco-labelling is being promoted in the country and across the East Africa region where conformity to some given environmental standards is a requirement. In addition, human development and capacity building through governments' investment in human health and education is a key driver to attaining green jobs.

Also, the devolution governments offer Kenyans a good opportunity to attain green growth and development. This is because more resources will be diverted towards area-specific needs with special emphasis on achieving sustainable development. Moreover, the increased government access to green funding such as GCF among other external sources of financing increases the capacity to invest more in the green economy. Additionally, the availability of reliable trade opportunities nationally, regionally and internationally allows the government to collaborate with the private sector in maximizing on the green market opportunities.

On the other hand, there are a number of factors that hinder the country's ability and willingness to shift to a green economy. Foremost is the inadequate compliance and weak enforcement of environmental laws and regulations which pose a big challenge towards sustainable development. Inadequate information on the available green technologies reduces the levels of their transfer and adoption. Additionally, there are some gaps in the skilled workforce on green growth. This limits the people abilities to fully utilize emerging green growth opportunities. Inadequate funding by government and development partners especially in the CSOs poses a potential setback in the realization and implementation of Eco-innovation relevant activities. The country also faces issues related to poor governance, such as corruption and lack of accountability for public resources which negatively impact Eco-innovation efforts. There is lack of awareness and a low level of literacy among the population concerning Eco-innovation development. This, therefore, does not bide well with efforts to embrace Eco-innovation since the people will not actively participate in holding the government and relevant institutions accountable. Financial constraints or poor allocation of available financial resources have led to poor up-scaling of innovations is also a big challenge in promoting Eco-innovation development in the country. Education is highly valued and has led to the development of skills and natural intelligence, which are core factors of Eco-innovation. The issue of policy incoherence and conflicting sectoral policies hinder Eco-innovation efforts. For instance, in the Finance Act 2018[12], zero-rating machinery purchases but increasing its maintenance costs promote its use on one side and discourages it on the other. There is also inadequate protection and registration of intellectual property rights (IPR) and licensing which is a major barrier to the development of innovations.

3.4.3 Eco-innovation related Policies and Frameworks in the Environment and Natural Resources sector in Kenya

Kenya has undergone unprecedented social, economic and political changes since independence. High population growth, as well as technological changes, have also been evident, which are important drivers of environmental change. The country faces a myriad of environmental challenges, thus prompting the formulation of various policies and institutional frameworks. For instance, the National Environment Policy of 2013 provides a policy framework upon which such challenges are to be tackled. The goal of this policy is to ensure a better quality of life for present and future generations through sustainable management and the use of the environment and natural resources. This policy is pursuant to climate-resilient, low carbon development as a national priority. Additionally, this policy recognizes the need to pursue a green economy path and minimizing carbon footprints to deliver the constitutional right to a clean and healthy environment.

The Government developed ***a public-private partnership (PPP) policy and Guidelines for the Use of Environment Economic Instruments in Kenya (2014)*** to support engagement with the private sector given the important role the latter plays in Kenya's development. NEMA's engagement with the private sector will be anchored on these policy frameworks. The authority sought to further develop PPPs it initiated with the private sector especially in promoting clean technologies and practices for the manufacturing and construction sectors, and waste management, among others. The expected output of this engagement was "enhanced private sector adoption of green technologies and practices". For the engagement with the private sector particularly, NEMA

[12] https://www.agroberichtenbuitenland.nl/landeninformatie/kenia/achtergrond/latest-developments/vat-and-agriculture-in-kenya-recent-law-changes

worked closely with the Kenya Association of Manufacturers (KAM) and the Kenya Climate Innovation Centre (KCIC) who are also partners in the Green Growth and Employment thematic programme. KAM was instrumental in identifying firms/entities requiring advisory services from NEMA on clean technologies and other green solutions, while KCIC linked KAM members with providers of locally developed clean technology solutions.

The Kenya Green Economy Strategy and Implementation Plan (GESIP) 2016-2030 focuses on the binding challenges that Kenya faces in the attainment of Vision 2030. It aims to ensure a low carbon, resource-efficient, equitable and inclusive socio-economic transformation. Its strategic and key thematic areas include promoting sustainable infrastructure, building resilience, ensuring sustainable natural resource management, promoting resource efficiency and ensuring social inclusion and sustainable livelihoods, all of which are intended to support the continued transition to a green economy (See Box 5 for details).

Environmental Management and Coordination Act (EMCA) (1999) Revised in 2012 recognizes the need to protect and conserve the environment. To achieve this, it directs the government authorities to conserve biological diversity and resources, protect the forests, protection of environmentally significant areas and natural resources and protection of the ozone layer through controlling human activities that deplete it.

Box 5: The Kenya Green Economy Strategy and Implementation Plan (GESIP) 2016-2030

Formulation of the Green Economy Strategy and Implementation Plan (GESIP) was spearheaded by the Ministry of Environment and Natural Resources, through an inter-agency steering committee chaired by the Principal Secretary. The GESIP macro policy framework identifies enabling conditions necessary for a rapid transition to a green economy, namely: maintaining macroeconomic stability for green growth; human development and capacity building; prioritization of GE implementation within the devolved government system; governance and sustainable structural transformation; sustainable financing; reduction in the cost of doing business; establishing a framework for extractive industries; sustainable trade regime through exploring market opportunities associated with the transition to a Green Economy; and creation of green, decent jobs.

It fucuses on the binding challenges that Kenya faces in the attainment of Vision 2030. It aims to ensure a low carbon, resource-efficient, equitable and inclusive socio-economic transformation. Kenya made an effort to gazette the banning of plastic bag in 2017 as proposed by EAC in the year 2011. The plastics bags were replaced with other alternative recommended environmental less degradation impact which embraced the aspect of Eco-Innovation.

https://www.kenyacic.org/news/green-economy-strategy-and-implementation-plan-gesip

The National Climate Change Response Strategy of 2010 appreciates the importance of integrating climate change information in the national policies since it is a major driving factor for economic growth. The purpose of this strategy is to put in place robust measures to address most challenges posed by climate variability and change. The goal of this strategy is to strengthen nationwide focused actions by ensuring the commitment and engagement of all stakeholders towards adapting to and mitigating against the adverse effects of climate change. To achieve this goal, the strategy recommends robust adaptation and mitigation strategies across different sectors

aimed at minimizing the climate change-related risks, while maximizing on the opportunities. Additionally, it recommends more research on climate change and the need to adopt/adapt and transfer new technologies. Among the proposed mitigation strategies is Kenya's participation in the carbon markets through the sale of Certified Emission Reduction (CER) credits to developed countries.

The National Wildlife Conservation and Management Policy of 2012 recognizes Kenya's richness in biological resources and its diversity in ecosystems, which significantly contribute to the national economy and wealth creation. This policy aims to create an enabling environment for the conservation of Kenya's rich diversity of species, habitats and ecosystems for the well-being of its people and the global community.

The Forest Policy of 2014 identifies climate change, land degradation and decreasing and low-quality water flows as key challenges facing the environment and forestry sector among others. The goal of this policy is to ensure sustainable development, management, utilization and conservation of forest resources and equitable sharing of the accrued benefits across generations of the Kenyan people. This policy supports research, training and technology transfer for sustainable development. It also enhances the management of forest resources to conserve soil, water biodiversity and environmental stability.

The Draft National Disaster Management Policy of 2010 aims at disaster management that focuses on minimizing the risks such as loss of life, economic and property loss. The majority of the risk factors identified in this policy are climate-related such as flooding, famine, and landslides among others. The policy calls upon the government to synchronize all policies and laws to safeguard the environment as well as encourage sustainable management of natural resources.

National Climate Change Framework Policy of 2016 focuses on the interlinkages between sustainable national development and climate change. Climate change adversely impacts key sectors that are important to the economy and society: Environment, Water and Forestry; Agriculture, Livestock and Fisheries; Trade; Extractive Industries; Energy; Physical Infrastructure; Tourism; and Health. This policy, therefore, elaborates intervention measures that can help to achieve the goal of low carbon climate-resilient development. This Policy was developed to facilitate a coordinated, coherent and effective response to the local, national and global challenges and opportunities presented by climate change. An overarching mainstreaming approach has been adopted to ensure the integration of climate change considerations into development planning, budgeting and implementation in all sectors and at all levels of government. The policy, therefore, aims to enhance adaptive capacity and build resilience to climate variability and change, while promoting a low carbon development pathway.

Table 15 below provides the relevant institutions that play a major role in the environment and natural resources sector.

Table 15: Eco-innovation relevant Institutions and actors in the Environment and Forestry sector - Kenya

Name of institution/actor	Roles they play in support of Eco-innovation
Ministry of Environment and Natural resources	It is the official policy organ of the government in this sector for the management and conservation of the environment. It is mandated to formulate policies, standards and procedures to support sustainable development.
National Environment Management Authority (NEMA)	It is the principal national government agency for the implementation of all environment-related policies, laws and regulations. It is also the accredited National Implementation Entity to access funding from the Adaptation Fund to support and mitigate the adverse effects of climate change.
Kenya Meteorological Department (KMD)	It facilitates access and interpretation of meteorological data, information and other related services. This serves as a source of scientific knowledge crucial in spearheading socio-economic growth and development. This also helps other sectors like agriculture to adapt and mitigate the adverse effects of climate change. It also supports other sectors by giving early warning signs to environmental catastrophes like drought and floods.
Department of Resource Surveys and Remote Sensing (DRSRS)	It is mandated to undertake natural resource collection, analysis, manipulation into resource maps and storage through remote sensing technologies. This information is used in policymaking decisions, conservation and sustainable use of these natural resources across various sectors.
Mines and Geological Department	It is mandated to undertake geological surveys, prospecting and research on mineral resources across the country. It also ensures the rehabilitation of abandoned mines and the construction of strong support for the active ones to prevent collapsing. Rehabilitation of deserted mines prevents the release of toxic greenhouse gases into the atmosphere, hence promoting a green economy and sustainable mining.
Universities	They conduct research and training on climate change adaptation and mitigation, as well as implanting new programs on climate change adaptation and mitigation.
Media	They play a key role in communication and creating awareness to the public on the prevailing environmental challenges and new technologies for climate change adaptation and mitigation.
Kenya Bureau of Standards (KEBS)	They ensure adherence to the set standards aimed at mitigating climate change, like emission trading and technology transfer.
Kenya Forestry Research Institute (KEFRI)	It is mandated to conduct research activities and production of new technologies that are friendly to the environment. For instance, it has introduced a technology that produces high-quality timber that increases economic returns.

Kenya Forestry Service (KFS)	Plays a crucial role in spearheading reforestation activities and programs across the country. Trees act as natural air purifiers acting as carbon sinks and releasing oxygen.
Kenya Wildlife Services (KWS)	Protects wildlife resources in their natural habitats. It has promoted Eco-tourism enabling the locals to benefit from wildlife conservation.

3.4.4 Eco-innovation related Policies and Frameworks in the Energy sector of Kenya

Energy is one of the key enablers of Kenya's Vision 2030 and the Big 4 Agenda development programs. Kenya treats energy security as a matter of national priority. The Third Medium Plan 2017-2022 identifies energy as the country's driver into "a newly-industrializing, middle-income economy, providing a high quality of life to all its citizens in a clean and secure environment." Kenya considers access to competitively priced, reliable, quality, safe and sustainable energy as an essential ingredient for the country's social-economic development[13]. The Kenyan energy sector is dominated by petroleum and electricity as the prime movers of the modern sectors of the economy, while other sources like wood fuel are mainly used by the poor. This sector has undergone massive transformations in the generation of green energy. Green initiatives in the energy sector include hydroelectric, geothermal power generation, solar energy, biogas energy, power production from the sugar processing sector among others. Some of the examples of initiatives aimed at promoting green economy are given in Box 6. The Energy sector has various regulatory and policy frameworks that are relevant to Eco-innovation.

Box 6: Global Innovation Index ranking, access to credit and energy innovations

Kenya has been ranked as the second leading innovation hub in sub-Saharan Africa and 6th Globally in access to credit and microfinance loans by the World Intellectual Property Organisation. This has accelerated technology development and enhanced movement towards a green economy. Charity Wanjiku and Tony Nyaga of Strauss energy, birthed their Solar Tiles Invention in the late 1990s after Kenyans experienced a 16-hour power blackout. They aimed to solve the never-ending electricity problem by introducing a speedy catalyst to the problem. A Technical University of Kenya student, irked by the charcoal and environment pollution energy consumption incidences invented an app that tracks your gas usage, letting you know when your gas is almost running out. According to the GII report, Kenya has a track record for recording high levels of innovation, outperforming on levels of innovation relative to GDP for the ninth consecutive year, an excellent record at per with other lower-middle-income countries like India, the Republic of Moldova and Vietnam.
http://www.invest.go.ke/kenya-ranked-top-tech-hub-sub-saharan-africa/

Article 42 of the Kenyan Constitution of 2010 is cognizant of the need to protect and conserve the environment and other natural resources. It states that Kenyans are entitled to a clean and healthy environment, both for the current and future generations. Article 69 emphasizes on sustainable use, management and conservation of the environment to ensure equitable sharing of the accrued benefits. In addition, it encourages Kenyans to ensure and maintain at least 10% of tree cover of the land area. It further urges the public to participate in the management, protection and conservation of the environment, thus supporting green growth.

[13] https://energy.go.ke/?page_id=439

The Sessional Paper No. 4 of 2004 on Energy, is a policy framework upon which cost-effective, affordable, quality and adequate energy services will be made available to the domestic economy while protecting and conserving the environment from the year 2004 up to 2023. This paper supports Eco-innovation by recognizing the contribution of renewable energy sources to the economy. To encourage wider adoption and use of renewable energy technologies like wind power, solar energy, biodiesel and power alcohol, the government will design incentive packages to promote private sector investments in renewable energy and also provide the requisite support for research and development in emerging technologies like cogeneration. However, no specific regulation or policy governing renewable energy sources.

The draft National Energy Policy of 2014 aims to ensure a sustainable, adequate, affordable, competitive, secure and reliable supply of energy to meet the domestic needs while protecting and conserving the environment. This is achieved through the promotion of efficient energy use and conservation, which is an important aspect of Eco-innovation. This policy also promotes diversification in energy supply, as well as government support in research and development.

Energy Act of 2006 revised in 2019 recognizes renewable energy sources in the country and their contribution to the economy. It directs the government to promote the development and use of renewable energy technologies like biomass, biodiesel, bioethanol, solar, wind, tidal waves, hydropower, biogas and municipal waste among others. It also directs the relevant authorities to promote clean development mechanisms such as carbon credit trading as a way of promoting the development and exploitation of renewable energy among other activities. This gives a clear implication of its support for Eco-innovation and green energy in the country.

Kenya is one of the countries to benefit from the ***Scaling-Up Renewable Energy Program (SREP)*** meant for low-income countries. The SREP aims to pilot and demonstrate the economic, social and environmental viability of low carbon development pathways in the energy sector. This is through the creation of new economic opportunities and increasing access through the use of renewable energy sources, thereby supporting Eco-innovation.

In 2008 the Kenyan government introduced ***the Feed-in Tariff (FiT) Policy*** based on its realization that renewable energy sources have the potential to increase domestic incomes, create employment, as well as contributing to energy supply and electricity diversification. FiT allows power producers to sell to the national grid and obligates the distributors to buy renewable energy, on a priority basis at pre-determined fixed tariffs for a given period. FiT's environmental integrity is to reduce greenhouse gas emissions and enhancing energy supply security.

Table 16 highlights the role of the key players in the Energy sector in promoting Eco-innovation.

Table 16: Eco-innovation relevant Institutions and Actors in the Energy sector – Kenya

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Energy	Is mandated to make and articulate energy policies to create an enabling environment for efficient operation and growth of the sector. It provides a long-term vision and strategies for all sector players.

The Electricity Regulatory Board (ERB)	Its role is to set, review and adjust consumer tariffs, approve power purchase agreements, promote competition in the sub-sector where feasible, resolve consumer complaints and enforce environmental, health and, safety regulations.
Energy and Petroleum Regulatory Authority (EPRA)	Its strategic objective is to protect the interests of energy users by ensuring that demand is met with reliable, cost-effective and high-quality energy services in an environmentally friendly manner.

3.4.5 Eco-innovation related Policies and Frameworks in the Agriculture sector in Kenya

The agriculture sector is a key contributor to the Kenyan economy in terms of food security, employment creation, provision of industrial raw materials, and a source of foreign exchange earnings. There exists a complex relationship between agriculture and the environment. While environmental degradation and associated climate effects have impacted negatively on the sector, agriculture on its part also contributes significantly to the environmental crises currently facing the country. Credible reports indicate that there has been an increase in deforestation to give way for agriculture. The sector, for example, is the main consumer of water resources (65%), followed by domestic use (18%) and industry (13%). To support sustainable development and green economy in the sector, various policy instruments have been put in place to guide and support the developments.

The Kenya Climate-Smart Agriculture Strategy (2017-2026) identifies the sector's vulnerability to climate change and extreme weather conditions. This strategy aims to ensure a sustainable, climate-resilient and low-carbon growth agriculture that enhances food security and contributes to national development goals. To achieve this, the strategy focuses on developing mechanisms that minimize greenhouse gas emission from agricultural production systems. Also, it aims to enhance the farmers' and pastoralists' adaptive capacity and resilience to the adverse effects of climate change.

The Agriculture Sector Development Strategy (2010-2020) is the blueprint for the agriculture sector to implement the Kenya Vision 2030. It envisions a food secure and prosperous nation through increasing productivity, commercialization and competitiveness of the agriculture sector. This strategy supports green growth through advocating for sustainable land management and scaling up suitable technologies for drought-prone areas. Moreover, it proposes some programs that adapt and mitigate against the adverse effects of climate change.

The Sessional Paper No. 8 of 2012 on National Policy for the Sustainable Development of Northern Kenya and Other Arid Lands, aims to strengthen the climate resilience of communities living in arid and semi-arid lands and ensure their sustainable living. It further recognizes the milestones achieved by these people in adapting to climate variability for many years. It also asserts that traditional skills and indigenous knowledge is becoming more valuable as the global challenges on climate change become more pressing. This policy supports a green economy by proposing sustainable measures to combat the effects of drought and climate change.

The sessional Paper No. 8 of 2008, Revised in 2015 on the National Livestock Policy identifies drought occurrence as an effect of climate change. The policy proposes various measures that increase the productivity of the livestock sub-sector, thus enhancing its contribution to food and

nutrition security in the country. This policy supports green growth in the country through the improvement of livestock management systems for the sustainable development of the industry. It also proposes the establishment of measures like a livestock insurance scheme, thus cushioning the livestock farmers against the risks associated with drought and climate change.

The National Oceans and Fisheries Policy of 2008 aims to ensure sustainable exploitation of fishery resources, their conservation and management. This policy instrument is eco-friendly since it proposes the use of adaptive and environmentally sustainable technologies and international practices in aquaculture. It proposes sustainable management and responsible use of the available fishery resources, to increase fish production and productivity, thus enhancing food and nutrition security and diversity in the country.

The Kenya National Adaptation Plan (NAP), 2015-2030 recognizes the threats posed on the economy by climate change and proposes actions to be undertaken to adapt and mitigate against it. NAP aims to enhance climate change resilience towards the achievement of the Kenya Vision 2030. This includes ensuring strong and sustainable economic growth and resilient ecosystems to support the livelihoods of the Kenyan people. Additionally, it focuses on enhancing the synergies between climate change adaptation and mitigation strategies to attain a low carbon climate-resilient economy.

Table 17 below provides the key actors in the agricultural sector in Kenya and their role in promoting Eco-innovation in the sector.

Table 17: Eco-innovation relevant Institutions and actors in the Agriculture sector- Kenya

Name of institution/actor	The role played in support of Eco-innovation
Ministry of Agriculture, Livestock and Fisheries	Mandated to formulate and coordinate the implementation of environmentally sensitive policies and strategies.
Kenya Agricultural and Livestock Research Organization	Responsible for conducting research and training on new and improved technologies that conserve the environment.
Universities	Conducts training, research and curriculum development reflecting environmentally sensitive practices.
Kenya Plant Health Inspectorate Services	Conducts inspection services of planting materials and products to ensure that they meet the required economic and environmental standards.
International NGOs (ILRI, CIAT, ICIPE, IITA, AGRA among others)	Conduct research on crops and livestock and also provide technical support to the Ministry of Agriculture.

3.4.6 Eco-innovation related Policies and Frameworks in the Trade and Industry sector in Kenya

Kenya's industrial sector has not been dynamic enough to function as the engine of economic growth compared to other emerging and more industrialized economies. The manufacturing sector is one of the key pillars of the Kenya Vision 2030 which aims to encourage a robust, diverse and competitive manufacturing sector. To green this sector, the government through the National Environment Management Authority (NEMA) and the Kenya Bureau of Standards (KEBS) is keen

on adopting eco-labelling. This will enable the identification of products that meet specific environmental standards. The country is also encouraging and promoting the use of cleaner and resource-efficient production through the Kenya National Cleaner Production Centre (KNCPC).

The Sessional Paper No. 9 of 2012 on the National Industrialization Policy Framework for Kenya 2012-2030 aims to promote and sustain a vibrant, globally competitive and diversified industrial sector for the generation of wealth and employment through the creation of an enabling environment. This policy is eco-friendly since it recognizes the need to promote sustainable industrial development that upholds environmental protection, management and efficient resource utilization. It facilitates innovation, adoption of cleaner technology, research and development and commercialization of research findings for industrial growth and sustainability.

The Manufacturing Priority Agenda (MPA) of 2018 as set out by the Kenya Association of Manufacturers highlights the need for the country to focus on the manufacturing sector and reignite its potential to achieve a multiplier effect on the economy, leading to increased investments, expanding markets, job creation and better living standards. Among its key pillars is securing the future of the manufacturing industry, through ensuring its operations are environmentally friendly and sustainable and keeping pace with the new technologies which necessitate continuous skills development. Moreover, the MPA promotes industry symbiosis to encourage a green economy and create a new culture of economic growth.

The National Trade Policy of 2017 articulates provisions geared towards promoting efficiency in the growth of domestic trade through transformational measures that address the constraints impeding the development of the wholesale, retail and informal sectors. To ensure more environment-friendly trade, this policy aims to enforce more eco-friendly trade and investment activities. Also, it directs the government to support and protect Intellectual Property Rights (IPRs) through more research, promoting and exploitation of IPRs and technology transfer.

Table 18 below provides the key actors in the Trade and Industry sector in Kenya and their role in promoting Eco-innovation in the sector.

Table 18: Eco-innovation relevant Institutions and actors in the Trade and Industry sector-Kenya

Name of institution/ actor	Roles they play in Eco-innovation
Ministry of Industrialization, Trade and Enterprise Development	It spearheads innovations and green initiatives at all levels, as well as formulating eco-friendly policies. The mandate of the Ministry is to promote Industrialization and Enterprise Development through: • Industrialization and Cooperative Policy formulation and implementation; • Implementation of the Industrial Property Rights regime; • Private Sector Development Policy and Strategy; • Quality Control including Industrial Standards development;

	• Co-operative Savings, Credit and other Financial Services Policy and regulation; • Development of Micro, Small and Medium Enterprises and Buy Kenya policy.
The Kenya National Cleaner Production Centre (KNCPC)	Promotes the application of cleaner industrial production technologies that enhance efficient use of raw materials, water and energy resources while minimizing waste generation at the source.
Kenya Association of Manufacturers (KAM)	Promotes the uptake of green growth technologies and best practices by the member organizations.
Kenya Accreditation Service (KENAS)	Is the sole National Accreditation Body (NAB) mandated to offer accreditation services in Kenya. It was established under the States Corporations Act, Cap 446; vide Legal Notice No. 55 of May 2009. It gives formal attestation that Conformity Assessment Bodies (CABs) are competent to carry out specific conformity assessment activities. KENAS is a member of the International Accreditation Forum (IAF) and an associate member at the International Laboratory Accreditation Cooperation (ILAC) which are apex organizations that oversee accreditation activities at a global level. KENAS carries out accreditation based on the following: regional directives; relevant statutes and government regulations; requirements for health, safety, and protection of the environment; and the market and needs of clients.
Kenya Bureau of Standards (KEBS)	KEBS was established in July 1974. The KEBS Board of Directors is known as the National Standards Council (NSC). It is the policy-making body for supervising and controlling the administration and financial management of the Bureau.
Kenya Industrial Estates Ltd	was established in 1967 to champion the development of Micro Small and Medium Enterprises (MSMEs) throughout the country with specific focus on clustering of industries, rural industrialization and value addition to locally available raw materials.
Kenya Industrial Research and Development Institute (KIRDI)	KIRDI is a national research institute established in 1979 under the Ministry of Trade and Industry and mandated to undertake multidisciplinary research and development in industrial and allied technologies. The Research and Technological Innovation (RTI) department handles the institute's core objectives. The major RTI divisions are Engineering, Energy and Environment, ICT, Leather & Textiles, and Food Technology Divisions.
Kenya Industrial Property Institute (KIPI)	The functions of the Institute are; • To administer Industrial Property Rights;

	• Provision of Technological Information to the public; • Promoting Inventiveness in Kenya and • Provision of Training on Industrial Property.

3.4.7 Eco-innovation related Policies and Frameworks in the Science, Technology and Innovation (STI) sector- Kenya

The GoK recognizes the key role played by Science, Technology and Innovation (STI) in wealth creation and building human capital required for the transition to a knowledge-driven economy. Vision 2030 proposes to intensify the application of STI to raise productivity and efficiency levels across the three pillars of national development. As a result, the Government is implementing the STI policy framework through the identification, acquisition, transfer, diffusion and application of relevant STI knowledge in all sectors of the economy. The Kenyan STI sector aims to integrate knowledge into all production systems of the economy. The ***Second Medium Term Plan of Vision 2030 (MTP2, 2013-2017)*** recommended intensifying the coordination of technology, innovation, research, development and commercialization for sustained productivity growth. The outcomes of STI driven economy include increased value added to production, increased income from high-value exports as opposed to raw material exports and increased production efficiency. The MTP is eco-friendly through its support for sustainable natural resource management across sectors as well as increased resource use efficiency through new technologies and innovations.

The Policy Framework for Science, Technology and Innovation of 2012 aims to mainstream STI across all sectors of the economy through generation, acquisition, dissemination and utilization of the available capabilities to achieve the Kenya Vision 2030. Among its guiding principles is the need for all STI institutions to be cost-effective which minimizes the cost of innovations thus maximizing on the returns. This policy supports Eco-innovation since it requires all institutions to put the effort into protecting and conserving the environment.

The Science Technology and Innovation Act of 2013 makes provision for the coordination and regulation of the progress of science, technology and innovation in Kenya. It establishes the National Commission for Science, Technology and Innovation to regulate and assure quality in the science, technology and innovation sector. The Commission shall be the successor to the existing National Council for Science and Technology. It also provides for the establishment of Advisory Research Committees within the Commission.

The Industrial Property Act of 2001 provides for the promotion of inventive and innovative activities, to facilitate the acquisition of technology through the grant and regulation of patents, utility models, technologies, innovations and industrial designs, to provide for the establishment, powers and functions of the Kenya Industrial Property Institute (KIPI). The draft Intellectual Property Bill, 2020 is being developed to address some of the shortcomings identified in this Act.
The Science, Technology and Innovation Strategy as outlined in the Vision 2030 underscores the importance of integrating STI in all sectors of the economy and ensure that Kenyans benefit from the available technologies. Among its strategic interventions, this strategy aims to strengthen and review the existing Intellectual Property Rights (IPRs) to identify, generate, acquire and protect indigenous resources and traditional knowledge. Additionally, it directs the exploration of alternative technologies to conserve and manage natural resources to harness maximum profits and to improve the livelihoods of the Kenyans. This is achieved through the acquisition of new and

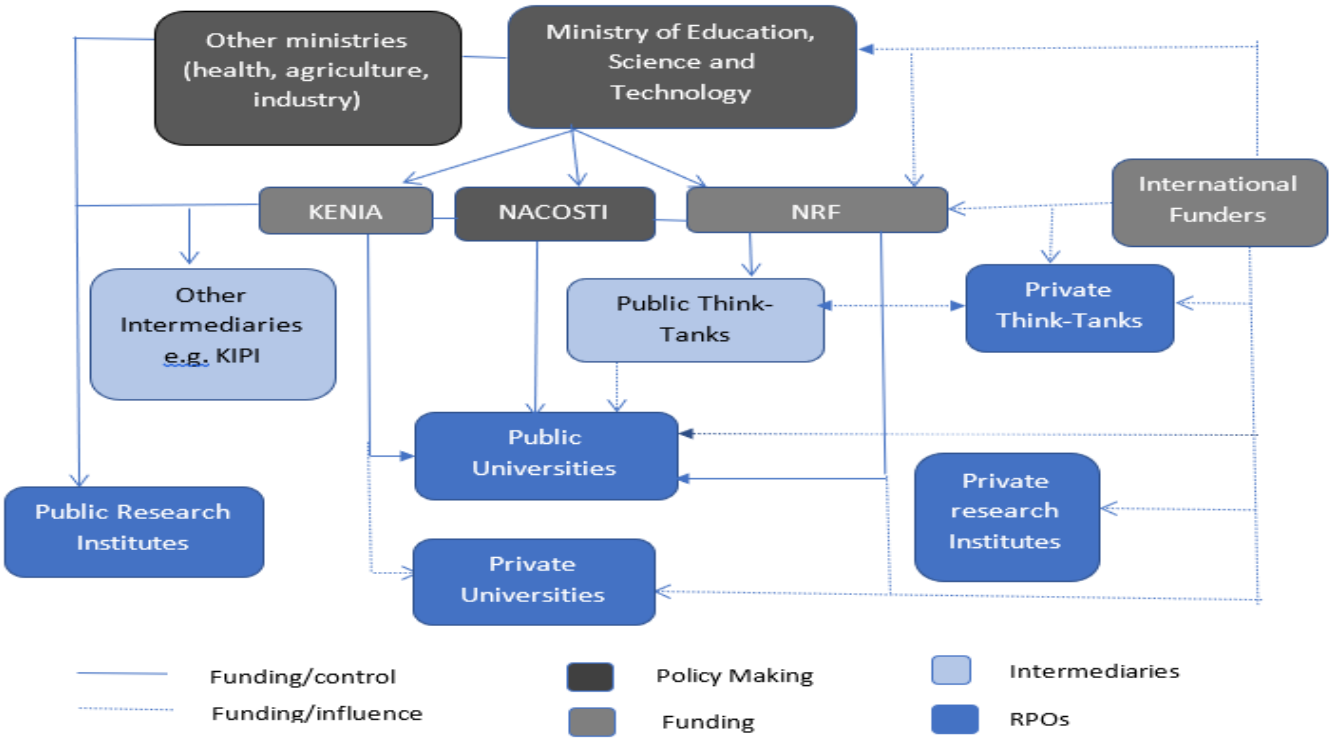
cleaner technologies and STI programmes for better management of natural resources and enhanced preparedness and ability to respond to natural calamities like climate change. The strategy also emphasizes on exploring alternative technologies to conserve and manage Kenya's natural resources; forecasting, natural resources; forecasting, early warning, prevention, mitigation of manmade and natural emergencies and hazards. There is a draft STI policy that is yet to be gazetted that incorporates all these issues. The key actors in the sector that support the implementation of STI policies and their role in Eco-innovation are provided in Table 19 below.

Table 19: Eco-innovation relevant Institutions and actors in the Science, Technology and Innovation Sector - Kenya

Name of institution/actor	The role played in support of Eco-innovation
The Ministry of Science, Technology and Innovation	It is responsible for policymaking, planning and coordination of eco-friendly innovations.
The National Commission for Science Technology and Innovation (NACOSTI)	Regulates and assures quality in the STI sector. Also advises the government on matters of science, technology and innovation. It also works with other sectors to restructure and rationalize research institutes for multi-disciplinary research. It is mandated to develop national STI priorities, leads inter-agency efforts to implement policies, accredits research institutes and grants licenses to undertake research activities. It also decides on funding priorities, develops and enforces relevant regulations and monitors STI progress.
The Kenya National Innovation Agency (KENIA)	Its mandate is to develop and manage the Kenya National Innovation system. It is tasked with establishing relationships among research actors and non-research actors, designating centres of excellence, disseminating scientific knowledge and technology, developing the national capacity and infrastructure to protect and exploit intellectual properties in research.
The National Research Fund (NRF)	It is mandated to mobilize and manage financial resources for KNIS to create knowledge, innovation and development across all fields. It also awards research contracts, grants and scholarships, finances the establishment of research facilities and supports research capacity building in the country.
Advisory Research Committees (ARCs)	They advise NACOSTI on programmes and projects to implement with regard to the identified priorities identified in the national STI policy. Also maintain a database of existing research programmes, projects and facilities.
Kenya Medical Research Institute (KEMRI)	Is responsible for conducting research and development activities within the health sector, as well as capacity building and training. It is also responsible for providing leadership in health research and development, shaping the health research agenda and setting norms and standards.
Kenya Institute for Public Policy Research and Analysis (KIPPRA)	Conducts objective research and analysis on public policy issues in order to advise the government policymakers. It also develops and maintains research resources and a database on public policy

	and other related issues and avails it to the government, the private sector and academic institutions when needed.

The stakeholder relationships in Kenya's research and innovation system have been highlighted in Figure 5 below. The structure has been relatively working well and there has been a marked improvement in coordination of research and development and STI over the years since this system was set up. However, some linkages need to be strengthened or developed to optimally achieve the desired outputs. A good example is the need to introduce the Industry-Research institutions link to allow for a search for solutions to industry challenges through research.



Source: DFID, (2019b)

Figure 5: Stakeholder relationships in Kenya's research and innovation system

3.4.8 Eco-innovation related Policies and Frameworks in the Transport Sector-Kenya

The Kenyan transport sector is a key contributor to the country's GDP and a source of employment for many. However, its real potential is usually underestimated since it acts as an intermediary service across other sectors of the economy. Therefore, it is paramount for the sector to offer adequate, effective and efficient services to society in an environmentally friendly manner. To achieve the Kenya Vision 2030 objectives, an efficient transport system is vital for facilitating national and regional integration, promoting trade, economic development, contributing to poverty reduction and wealth creation.

The Kenyan Integrated National Transport Policy of 2009 aims to develop, operate and maintain an efficient, cost-effective, safe, secure and integrated transport system that links other sectors in a socially, economically and environmentally sustainable manner to achieve national and

international development agenda. This policy has established user and polluter pay principles to facilitate economic efficiency as well as generate sufficient revenues in the sector while eliminating distortions relating to user choice of mode of transport and externalities in production and consumption like pollution and congestion. This policy is eco-friendly since it incorporates environmental protection and resource conservation among its key strategic interventions.

The Nairobi Non-Motorised Transport (NMT) Policy of 2015 is a county-level transport policy formulated by the Nairobi City County Government. This policy aims to develop and maintain a transport system that fully integrates non-motorist transport as part of the transport systems within the county. This was motivated by the fact that the majority of the city dwellers was daily for their day-to-day activities. According to this policy, NMT includes pedestrians, bicycles, hand-driven carts, use of animals like horses, camels and donkeys and animal-drawn carts. This policy recognizes the immense benefits that NMT offers to the community. Among others, it pinpoints that NMT contributes to cleaner air through reduction of air pollution, thus minimizing the greenhouse gas emissions by motorists, thus contributing to the green initiatives in the sector.

The Draft National Road Safety Action Plan 2015-2020 focuses mainly on safety issues in the transport sector. This Action Plan aims to significantly reduce fatalities by 50% by 2020. Given that road transport is the main mode of Kenyan transport, one of the key strategic interventions of this plan is to ensure vehicle safety standards and compliance. To achieve this, this Action plan intentions to improve awareness of standards and compliance among motorists and law enforcers, increase the capacities of the relevant bodies to monitor and enforce the standards, as well as introduce motor vehicle emission standards. Although this action plan does not explicitly support Eco-innovation, its drive to control, monitor and enforce emission standards is an eco-friendly practice.

The National Transport and Safety Authority Strategic Plan of 2016-2020 aims at efficient, reliable and safe road transport in Kenya. This is achieved by continually improving the accessibility of the Kenya road transport system for all users. Among the strategy's core values is the commitment to putting all available resources to their best and most efficient use for optimal results in service delivery and meeting their goals. The strategic drive of this plan is to attain financial sustainability, ensuring the right people are in the right place, stakeholder collaboration and investment in innovation. This is through a renewed focus and investment in new technologies, research and efficient resource use. As part of its innovative measures, the strategic plan recommends the introduction of cashless payment modes for public service vehicles like e-ticketing and pay-card systems by 2020, which is an eco-friendly practice. Table 20 below provides the key actors in the Transport sector in Kenya and their role in promoting Eco-innovation in the sector.

Table 20: Eco-innovation relevant Institutions and actors in the Transport Sector - Kenya

Name of Institution/actor	The role played in supporting Eco-innovation
Ministry of Transport, Infrastructure Housing, Urban Development and Public Works	Responsible for ensuring an efficient, safe and cost-effective transport system that meets the country's transportation objectives in a socially, economically and environmentally friendly manner.

National Transport and Safety Authority (NTSA)	It is mandated to enforce regulations geared towards the reduction of air pollution by motor vehicles, thus protecting the environment.
Kenya National Highways Authority (KeNHA)	It's mandated to develop, manage, rehabilitate and maintain national trunk roads taking into consideration environmental safeguards. It also conserves and protects the environment as well as ensuring that all environmental regulations are adhered to in the execution of its mandate.

3.4.9 What works, what doesn't work and why in Kenya

This section discusses some of the initiatives and actions that have worked or failed to work for some reason. Policies and strategies that attributed to those initiatives and actions in Kenya have also been provided alongside the reasons for the success or failure of the initiatives.

3.4.9.1 What works and why

a) The banning of manufacturing and use of plastic bags

Supporting policies and Strategies: National Environment Policy 2012, EMCA 1999, Vision 2030, Environmental Regulations- gazette notice No. 2356 of 14th March 2017 and the EAC Polythene Materials Control Bill, 2016.

Description and impact*:* Kenya led the banning of plastic bags in 2017 as proposed by EAC in the year 2011. The plastics bags were replaced with bags made of biodegradable materials in line with Eco-innovation. This was a gazette notice No. 2356 of the Kenya Environmental Management and Co-ordination Act. The banning of plastic bags prompted the innovation and development of other environmentally friendly alternative products for similar use. According to an internal assessment by Kenya's National Environment Management Authority (NEMA), 80% of the population has stopped using plastic carrier bags since the ban was adopted. KAM claims that the plastic bag ban led to loss of jobs, investments and markets as some manufacturers closed their businesses and others relocated to other countries but it also brought new business opportunities and diversification of operations to produce fabric-based bags, non-woven bags, pulp paper-based bags amongst others which is consistent with Eco-innovation.

***Reasons for success*:**

- Multi-agency cooperation in the enforcement of the ban
- Development of more biodegradable alternatives
- Strong participation and support from CSO, Media and the private sector

b) Implementation of various Environmental Policies, Projects and Initiatives

Supporting policies and strategies: The Constitution 2010, Vision 2030, EMCA 1999, National Environment Policy 2012, the Green Economy Strategy and Implementation Plan (GESIP) 2016-2030, International Environmental Conventions and Treaties-CITES, Paris Agreement, public-private partnership (PPP) policy and Guidelines for the use of Environment Economic Instruments in Kenya (2014).

Description and impact: Environmental policies are receiving increasing attention from Kenyan policy and decision-makers and the public. It is recognized that the future of economic growth lies

in fostering sustainable development that incorporates environmental policies and considerations. It is also noted that mitigating environmental health impacts can strengthen development. However, these necessities require collaboration between national and county governments, as well as private-public synergy in planning and implementing environmental conservation and management activities to address environmental challenges**.**

In response to many pressing economic, environmental and social concerns, such as increasing rural to urban migration, need for job creation and environmental degradation, Kenya has established some policies and strategic plans for a green economy such as the Green Economy Strategy and Implementation Plan (GESIP) 2016-2030. For efficient use of the available natural resources, different sectors have different guidelines and policies that are aimed at ensuring sustainability. The overall national development objective of the government is anchored on accelerating economic growth and increasing productivity across all sectors, ensuring equitable distribution of national revenues, poverty alleviation through provision of basic needs to the citizens, enhanced agricultural production, promoting industrialization and employment creation. It aims to ensure a low carbon, resource-efficient, equitable and inclusive socio-economic transformation. Its strategic and key thematic areas include promoting sustainable infrastructure, building resilience, ensuring sustainable natural resource management, promoting resource efficiency and ensuring social inclusion and sustainable livelihoods, all of which are intended to support the continued transition to a green economy.

Various Acts of parliament and policies have established critical institutions that are mandated to implement them. For instance, the EMCA of 1999 established the NEMA which is mandated to coordinate all environmental issues in the country. NEMA in 2017/18 successfully carried out a total of 1,518 compliance audits and verifications inspections against the planned target of 1,400; hence accounting for a 108% success. Numerous restoration activities of the critical degraded fragile ecosystem were undertaken and key findings of concern at the time were issues pertaining to site restoration, securing of sedimentation tanks, alien species, biodiversity offset, fish ladder, water stagnation, aquatic weed and soil erosion among others. The Authority has also observed the regeneration of the ecological functions of wetlands such as Limoto, Rwizi wetland systems, and Nakivale lakeshores among others. Restoration of approximately 1000ha of various wetland systems has also been documented. The Act was later revised in 2012. It is from this establishment that the subsequent policies and regulations in collaboration with lead government agencies such as the Ministry of Environment and Natural Resources that banned the production, importation and use of plastic bags that have led to huge environmental improvement in the country and the development of environmentally friendly replacement products for packaging. The institution has come up with important Regulations and Standards that can be used in monitoring and abating environmental degradation. However, poor enforcement and lack of capacity have led to poor implementation.

The International Environmental conventions such as the CITES and Paris Agreement have helped the government and CSO to develop capacity relating to the environment over the years. They have instilled a sense of responsibility in the government and forced it to comply and provide the necessary structures that lead to their implementation. Kenya for example has complied with the Paris Agreement of developing NDCs that are aimed at curbing global climate changes by reducing emissions.

The Government developed a public-private partnership (PPP) policy and Guidelines for the use of Environment Economic Instruments in Kenya (2014) to support engagement with the private sector given the important role the latter plays in Kenya's development. NEMA's engagement with the private sector will be anchored on these policy frameworks. The authority sought to further develop PPPs it initiated with the private sector especially in promoting clean technologies and practices for the manufacturing and construction sectors, and waste management, among others. There has been enhanced private sector adoption of green technologies and practices in Kenya. NEMA worked closely with the Kenya Association of Manufacturers (KAM) and the Kenya Climate Innovation Centre (KCIC) who are also partners in the Green Growth and Employment thematic programme. KAM was instrumental in identifying firms/entities requiring advisory services from NEMA on clean technologies and other green solutions, while KCIC linked KAM members with providers of locally developed clean technology solutions. The PPP arrangements in public research organizations have led to the development of technology Hubs that have helped young innovators to come up with solutions that directly impact the people or support industries to be more efficient especially in reducing resource utilization and energy. These outputs have made Kenya be internationally recognized as a major contributor to important innovations.

***Reasons for success*:**

- Anchorage in the country constitution and well guided by existing strategies and development plans
- Establishment of Implementing and enforcing institutions.
- Kenya's commitment to environmental conservation is key to the economic development of Kenya. Kenya recognizes the importance of the environment and urges its protection as is the basis that will guarantee the healthy living of its citizens.
- Well-coordinated multi-agency implementation
- CSO and private sector participation was well incorporated
- Strong anchorage in policy

c) Renewable Energy Development Initiatives

Supporting policies and strategies: The Constitution 2010, Vision 2030, Energy Act 2019, Paris Agreement, draft National Energy Policy of 2014 and the Feed-in Tariff (FiT) Policy of 2008 revised in 2010.

Description and impact: Kenya is one of the countries that benefited from the Scaling-Up Renewable Energy Program (SREP) that targeted low-income countries. The SREP aimed to pilot and demonstrate the economic, social and environmental viability of low carbon development pathways in the energy sector. This is through the creation of new economic opportunities and increasing access through the use of renewable energy sources. This vision for green energy is further emphasized in the Government's Vision 2030, which identifies reliable, clean and affordable energy as a foundation for Kenya's long-term economic and social development. Policy and regulatory measures are in place to boost power generation from renewable energy sources. The Energy Act of 2006 confers the responsibility for generation and transmission system planning to ERC, which has overseen the preparation of a Least Cost Power Development Plan (LCPDP). To mobilize investment for the Plan, the government prepared an Electricity Access Investment Program 2009-2014.

The government initiated the Kenya Off-grid Solar Access Project (KOSAP) for the electrification of institutions far from the grid using solar PV systems. An estimated 200,000 rural households in Kenya have solar home systems and annual PV sales in Kenya are between 25,000-30,000 PV modules. In comparison, Kenya's Rural Electrification Fund, which costs all electricity consumers 5% of the value of their monthly electricity consumption (currently an estimated 16 million US$ annually), is responsible for 70,000 connections. With access to loans and fee-for-service arrangements, estimates suggest that the Solar Housing Systems (SHS) market could reach up to 50% or more of unelectrified rural homes. There are about 4 million households in rural Kenya alone which present a vast potential for this virtually untapped technology.

The Renewable Energy Feed-in Tariff was established in 2008 and revised in 2010, which resulted in the addition of three renewable energy sources: geothermal, biogas, and solar energy resource generated electricity. Renewable energy in Kenya accounts for over 70% of the installed power capacity including large hydroelectric power. It also accounts for more than 70% of the power generation, but production varies from year to year with hydropower production falls in dry years. The government is supporting a Solar PV electrification of public institutions, including health facilities. So far, 1,500 institutions have been electrified. Under the Feed-in-Tariff (FiT) policy, 278 renewable energy projects with a combined capacity of over 4.7 Gigawatts have been approved and are at various stages of implementation. This includes wind power, geothermal power, and solar PV power projects. Kenya commissioned three renewable power projects: 310 MW wind (Lake Turkana wind power project), 100 MW Kipeto (Kajiado) and 51 MW solar (Garissa).

***Reasons for success*:**

- Kenya is endowed with plentiful indigenous renewable energy resources.
- Enabling policy and regulatory reforms.
- Established key institutional mechanisms. The Ministry of Energy has a dedicated Directorate focusing on renewable energy. The government also set up a "Green Energy Task-Force" which was mandated to ensure the expansion of the generation of green / clean energy.

3.4.9.2 What doesn't work and why

a) Poorly established National Research Fund (NRF)

Supporting policies and strategies: STI Act of 2013 and Vision 2030

Description and impact: Alongside NACOSTI and KENIA, NRF was established by the STI Act of 2013 to mobilize and manage financial resources on R&D. NRF's activities cover research grant calls categorized as postgraduate research grants that aimed at alleviating the problem of ageing scientists; multidisciplinary support grants that targeted establishment of links between different R&D actors and organizing technology transfer; and infrastructural support grants that targeted "state of the art" research infrastructures prioritized by NACOSTI. Through co-funding research programmes, NRF has managed to strategically partner in transformative innovation policy programmes such as Horizon 2020 of the European Union. So far NRF has achieved very little compared to what it is mandated to do.

Reasons for Failure:

- Conflict of interest and excessive political interference.
- Lack of human resource capacity- Very lean number of staff with insecure security of tenure. For instance, the current acting CEO has not been confirmed for over 5 years now.

Other factors that have not worked well in the development of Eco-innovation in Kenya include *Inadequate funds to support research and innovation*. There is still a huge gap to be filled in the provision of research infrastructure and facilities. Many public research institutions largely depend on donors to provide necessary equipment for various research activities. Kenya is yet to allocate the 1% of GDP it committed to support R&D. *Rampant corruption has negatively impacted the efforts made in securing research funds*. This is evidenced by the low scores of 31 points in the Corruption Perception Index (CPI).

3.5 Eco-innovation Related Policies and Institutions in Malawi

3.5.1 Overview

Located in Southern Africa, Malawi is landlocked, sharing its borders with Mozambique, Zambia and Tanzania. According to the 2018 Census, the country has an estimated population of 17.5 million, which is expected to double by 2038[14]. Malawi remains one of the poorest countries in the world despite making significant economic and structural reforms to sustain economic growth. The economy is heavily dependent on agriculture, employing nearly 80% of the population, and it is vulnerable to external shocks, particularly climatic shocks. In 2019, Malawi's economic growth is projected to reach 4.4%, increasing over the medium term to 5.0 - 5.5%. Growth in 2019 is buoyed by a good harvest overall, despite the impact Cyclone Idai. Solid agricultural growth is likely to support agro-processing and households' disposable incomes, which should, in turn, drive the service sector.

The country's development is guided by the ***Malawi Growth and Development Strategy (MGDS),*** a series of five-year plans that contribute to the long-term goals outlined in Vision 2020. ***Malawi's Vision 2020[15]***' aligns policy strategy to develop the country so that it is, among other things, environmentally sustainable, culturally vibrant, technology-driven, and self-reliant, with effective provision of social services and equal opportunities for all. The current MGDS III, "Building a Productive, Competitive and Resilient Nation," will run through 2022 and focuses on education, energy, agriculture, health and tourism. Malawi's development challenges are multi-pronged, including vulnerability to external shocks such as weather and health, rapid population growth and environmental degradation. Infrastructure development, the manufacturing base, and adoption of new technology are low, and corruption levels remain high with Transparency International ranking Malawi at 123/180 economies in 2019. Other challenges include macroeconomic instability, poverty, food shortages and inequality. There is therefore a clear need for innovative social and environmental products and services to address these challenges (Habberton et. al., 2017).

[14] https://www.worldbank.org/en/country/malawi/overview
[15] http://www.sdnp.org.mw/malawi/vision-2020/

The ***Constitution of Malawi*** provides in Chapter III, article 13, on Principles of national policy, "*The Environment: in order to manage the environment responsibly: prevent the degradation of the environment; provide a healthy living and working environment for the people of Malawi; accord full recognition to the rights of future generations by means of environmental protection and the sustainable development of natural resources; and conserve and enhance the biological diversity of Malawi."* The constitution does not, however, have provisions for Energy, Agriculture, Forestry, Fisheries, Land & property and Livestock. This provision nevertheless provides a basis for pushing for Eco-innovation and increased recognition of ecological aspects and wellbeing of the people and not just economic benefits.

Malawi has a ***National Science and Technology Policy (NSTP) of 2002*** that put in place strategies that will enable the country to achieve a technology-based development. The promulgation of this policy underscores the important role Malawi attaches to the development and application of STI in national socio-economic development (Government of Malawi [GoM], 2002). However, this policy is under review and does not address the current challenges and needs to be aligned with the national development plans and policies. The issues to be considered include sustainable industrialization models that ensure green economic growth; capacity strengthening in foresight, to be able to conduct a systematic analysis of STI; support to convene regular dialogues with policy-makers (e.g., parliamentarians, ministers and Presidents, etc.) to exchange, share and disseminate data-derived key messages, or to advocate for increased investment in research and innovation among others.

Malawi Development Strategy (MGDS III) has identified five key priority areas (KPAs). These are: (i) agriculture and climate change management; (ii) education and skills development; (iii) energy and industrial development; (iv) transport and ICT infrastructure development; and (v) health and population management (GoM, 2017a). Being the national blueprint, the MGDS III guides the implementation of development activities among different stakeholders including the government Ministries, Departments and Agencies (MDAs); CSOs; the private sector; academia; research institutions; development partners and the general public. The Government will continue using Sector Working Groups (SWGs)[16] as a means of implementing the National Development Strategy as well as fulfilling and domesticating international commitments and ensuring aid effectiveness. With membership spanning across different stakeholders, SWGs will continue to be a relevant mechanism for implementing the MGDS III. The Strategy also recognizes that many important sectors of the economy rely on the environment and natural resources to enhance their productivity. The degradation of the environment and natural resources is a major threat to social and economic development. These include deforestation; decreasing soil fertility and increasing erosion; water depletion, loss of biodiversity; and increasing pollution and vulnerability to climate change. The environment and natural resources must be sustainably managed.

3.5.2 Enablers and/or constrainers of Eco-innovation in Malawi

The government of Malawi understands the need to support eco-inclusive entrepreneurship and as such has developed policies that promote such innovative businesses (Habberton et. al., 2017). One of the main drivers of Eco-innovation is the availability and reliability of hydroelectric power.

[16] In 2008, government instituted 16 Sector Working Groups (SWGs) as a coordination mechanism for planning, implementation and review of sector activities.

This also ensures that there is reliable internet connectivity for research and development work. Malawi also has trained manpower to work in the new sector coupled with a large population of unemployed youth whose skills can be useful in technology advancement. The country has well-established donor relations that enable it to make milestones in Eco-innovation compared to other African states. The peaceful political environment in Malawi is a great asset for Eco-innovation advancement as donors and other stakeholders have the confidence in completing innovative projects without interference.

The GoM has good policies that favour the Eco-innovation agenda for the country. Administratively, the government has provided a One-stop-shop for permits and land applications for investors, traders and exporters as well as established online registration of business. However, it is also struggling with infrastructural development to support these and in fact, there were challenges in implementing this outside Blantyre at a time. The people of Malawi are generally innovative and have plenty of business ideas. Youth especially have high levels of enthusiasm (Habberton et al., 2017). This, therefore, is providing a good environment for Eco-innovation to thrive if they are adequately supported. This would help the Malawian people to have a serious focus and concern on the environment which is currently not being taken too seriously by the people. However, Eco-innovation in Malawi is still at its embryonic stage and faces a lot of challenges. These include the inability of innovators to partner with institutions and the lack of funding to advance Eco-innovation. Innovators thus find it difficult to progress with their innovations due to lack of capital.

3.5.3 Eco-innovation related Policies and Frameworks in the Energy Sector- Malawi

Malawi has committed to achieving "Sustainable Energy for All", as enshrined in SDG number 7. Energy is a means to an end; it provides a platform for social and economic development and a pathway for achieving many of the other SDGs. The MGDS III recognises this central role of energy, citing it as "the lifeblood of the economy", and laying out a goal to "provide sufficient sustainable energy for industrial and socio-economic development". Improved access to reliable and sustainable energy supply is one of the core outcomes the MGDS III seeks to achieve. Long and persistent load shedding has negatively affected industrial development in Malawi. There is need for a reliable power supply to support a growing economy. The generation of electricity and provision of alternative sources of energy is critical to transforming the country into a productive, competitive and resilient economy. Energy is needed at different levels including households, industrial production and provision of social services such as education and health.

The Government recognizes that reliable energy is needed if industries are to improve production. Furthermore, reliable energy would attract investors to ply their business in Malawi. Energy development is one of the most important aspects in improving the environment for private sector development which would also promote private sector investment in the country. Private Sector Development is recognized as the engine of economic growth in Malawi. As such, industrial development has been highlighted as a priority area. The trade, industry and private sector development strategy will help in achieving that. The strategy aims to build Malawi's productive base and its export capacity in a manner that empowers the poor, farmers, youth, women and other vulnerable groups.

The National Energy Policy of 2018 and ***the Malawi Renewable Energy Strategy of 2017*** build on the targets laid out in the ***Sustainable Energy for All Action Agenda of 2017*** and provide high-level policy direction, complemented by the detailed technical analysis made available in the most recent ***Integrated Resource Plan of 2017***. The Energy policy 2018 goal is to increase access to affordable, reliable, sustainable, efficient and modern energy for all Malawians. It will, among other things, enhance electricity generation and distribution to all those who need it for domestic and industrial use. To improve access to energy, the Government will continue to undertake rural electrification through the establishment of the Rural Electrification Agency as a semiautonomous legal entity to manage rural electrification activities, the Rural Electrification Fund and renewable energy activities. The Government will promote the use of solar and other renewable energy sources in rural areas to reduce deforestation across the country. The National Industrial Policy is also important in the implementation of MGDS III since it will help increase the proportion of manufacturing in GDP by enhancing the productivity of the sector. This will be supported by education and skills development interventions such as the introduction of community colleges to capacitate the youth in rural areas. The Energy sector in Malawi has various actors as provided in Table 21.

Table 21: Eco-innovation relevant Institutions and actors in the Energy Sector- Malawi

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Natural Resources, Energy and Mining (MoNREM)	Oversees the whole Energy sector development.
Ministry of Finance	Budget approval for energy plans and projects
Ministry of Lands	Approval of land permits
Malawi Energy Regulatory Authority (MERA)	Sets tariffs, approves licenses and oversees the quality of service in the energy sector.
Department of Energy Affairs (DoEA)	Oversees national energy planning and sets policy
Electricity Generation Company of Malawi (EGENCO)	Produce electricity
Electricity Supply Corporation of Malawi (ESCOM)	ESCOM purchases, transmits and distributes electricity.
Malawi Investment and Trade Centre	Guides private investors entering the market
Independent Power Producers (IPPs)	Production of electricity

3.5.4 Eco-innovation related Policies and Frameworks in the Environment and Natural Resources Sector- Malawi

Environment and natural resource management are the bedrock of national wealth especially for an agro-based economy such as Malawi. The costs of environmental degradation are very high though rarely highlighted owing to the widespread conception that environmental resources are free goods. These costs exact a heavy toll on the poor who are entirely dependent on these resources and therefore exacerbate the problem of environmental degradation.

Malawi has adopted and enacted policies and legislation on environment and natural resources including the ***National Environmental Policy and the Environment Management Act, the***

National Forestry Policy and the Forestry Act, the National Water Policy and the Water Resources Act, the Wildlife Policy and the National Parks and Wildlife Act. These provide different mechanisms and strategies for implementing and enforcing these various instruments. Many of the policies and legislation are however not implemented. As the National Environmental Action Plan, 1994, 2002 noted, Malawi continues to face increasing environmental and natural resources degradation including soil erosion, water pollution, deforestation, overfishing, poaching.

There are several challenges to the effective implementation of environment and natural resources management policies and legislation. Poverty, overpopulation and the resulting resource scarcity, capacity constraints within the relevant institutions as well as inherent policy incoherence make coordination difficult to achieve. Various institutions continue to improve on their respective policy and legislation framework as well as the systems to ensure effective implementation and enforcement. Below, we discuss the existing policy frameworks, strategies and plans in the Environment and Natural Resources sector as well as the respective institutions mandated to implement these.

The overall goal of the ***National Environmental Policy (NEP) of 1996 revised in 2004 and the Environment Management Act of 1996*** is to promote sustainable social and economic development through the sound management of the environment and natural resources. This Policy has enumerated sectoral policy objectives and strategies (GoM, 2004). Its goals include security for all persons, now and in the future, an environment suitable for their health and wellbeing; promote sustainable utilization and management of the country's natural resources and encourage, where appropriate, long term self-sufficiency in food, fuelwood and other energy requirements; Facilitate the restoration, maintenance and enhancement of the ecosystems and ecological processes essential for the functioning of the biosphere and prudent use of renewable resources among others. Key to Eco-innovation is the promotion of the ecosystems management approach to ensure that sectoral mandates and responsibilities are fully and effectively channelled towards sustainable environment and natural resources management as well as ensuring participation of the local community, NGOs and private sector in the environment and natural resources management.

The National Forestry Policy of 1996 and the Forestry Act of 1997 call for communities and the private sector to be given a greater role in managing and using forests, and for government to focus on regulating, planning and providing guidance. Malawi laid some solid foundations for good forestry linked to improved livelihoods with its 1995 Constitution and with the passing of the National Forestry Policy in 1996, and the Forestry Act in 1997. The main emphases of the Policy and Act are: strengthening core roles of government (planning, programming, monitoring, regulating, extension, managing protected areas); increasing involvement of the private sector and civil society; empowering communities to manage forest resources on customary land and, in collaboration with government, on reserves; engaging with international obligations and processes; and coordinating with other sectors (GoM, 1996).

The National Water Policy of 2005 aims to address all aspects of water including resource management, development and service delivery. The policy has articulated the water sector vision of '*Water and Sanitation for All, Always*.' The vision embraces and reflects the Government's overall development objectives of poverty reduction and economic prosperity, and at the same

time aims at conforming to the regional and global trends. The Policy comprehensively covers areas of water resource management and development, water quality and pollution control, water utilization, disaster management and institutional roles and linkages (GoM, 2005). To this end, the Government of Malawi has developed this Water Policy to guide the country in the management and development of its water resources using the IWRM principles, improving the institutional and legal framework, ensuring sustainable delivery of water supply and sanitation services, effective involvement of the private sector, protection of the environment and conformity with the regional and international conventions and agreements in the management of shared water resources.

Wildlife Policy of 2000 and the National Parks and Wildlife Amendment Act of 2004 seeks to bring about significant changes in the management of wildlife. For example, the management of protected areas was previously under the exclusive mandate of the central government. However, the policy now proposes collaborative management allowing the participation of local communities living close to protected areas. The policy acknowledges that the participation of these communities is essential for good management. It further provides that arrangements and mechanisms should be agreed upon for each protected area for purposes of the fair distribution of the benefits amongst surrounding communities. Strategies to implement this include: a) Improve law enforcement capabilities: sensitize communities on the need for such laws; establish rules of engagement during anti-poaching campaigns; b) Develop and implement guidelines for involving local communities, NGOs and the private sector in planning and executing management activities; and c) Establish guidelines for awarding and monitoring concessions to private tourism operators. Support local communities to actively benefit and participate in ecotourism.

The National Biosafety and Biotechnology Policy of 2008 provides a framework for the effective implementation of biotechnology programmes and activities. The goal of the policy is to attain sustainable socio-economic development through research, acquisition and use of traditional and modern biotechnology. Malawi has several Acts, Regulations and Policies relating to biological diversity including legislation that specifically addresses biotechnology and biosafety. These include; the Biosafety Act of 2002; the Biosafety (Management of Genetically Modified Organisms) Regulations, 2007; the National Biosafety and Biotechnology Policy as well as various Handbooks and Guidelines.

The National Biodiversity Strategy and Action Plan (NBSAP) II 2015-2025 outlines the status of the biological resources in Malawi and provides strategies, targets and actions to be taken to ensure their sustainable management. Malawi recognizes the importance and the need to conserve biodiversity. In 2006, the Malawi Government developed the first National Biodiversity Strategy and Action Plan (NBSAP) as a tool for biodiversity management (GoM, 2015a). The NBSAP provides an avenue for achieving long term goals on conservation and sustainable use of biodiversity following the Constitution, National Environmental Policy 2004 and Environment Management Act 1996 and other national and sectoral policies, plans and strategies, therefore, fulfilling most of the Eco-innovation principles.

The National Climate Change Management Policy (NCCMP) of 2016 is a key instrument for managing climate change in Malawi. The goal of the policy is to create a legal framework for a pragmatic, coordinated and harmonized approach to climate change management. The Policy provides strategic direction for Malawi's priorities for climate change interventions and outlines

an institutional framework for the application and implementation of adaptation, mitigation, technology transfer and capacity-building measures (GoM, 2016a). Environmental degradation and climate change have emerged as major development issues that have adversely impacted food, water and energy security, thereby frustrating government efforts to improve the general livelihoods of both urban and rural communities. Scientific evidence in Malawi shows an increase in frequency, intensity and magnitude of extreme weather events over the last two decades. This policy discusses the Government initiatives and processes taken to assist vulnerable communities and ecosystems to adapt and mitigate both current and projected climate change impacts through increased adaptive capacity and resilience.

Malawi's National Adaptation Plan Framework of 2020 was produced by the Government of Malawi (GoM), Ministry of Natural Resources, Energy and Mining, with financial and technical support from the National Adaptation Plan (NAP) Global Network to guide efforts to develop its National Adaptation Plan with an effort to address climate change. The Malawi NAP process uses seven main approaches; a systems approach; horizontal and vertical integration; community-based participatory approach (CBPA); evidence-based approach; gender and human rights approach; and leveraging the private sector (GoM, 2020). In line with the principles established by the UNFCCC and also in line with Malawi's development goals, the guiding principles for the NAP process are: sustainable development, uplifting the poor and the vulnerable, gender, participation and ownership, incorporating traditional and Indigenous knowledge, and financial accountability and integrity. The development of this framework and the implementation of the NAP are linked to both national and international development strategies and goals such as the Malawi Growth and Development Strategy I, II and III, Vision 2020, the SDGs, the Sendai Framework on Disaster Risk Reduction 2015-2030 and the 2063 Agenda of the African Union. It has also been guided by various national and regional development policies such as the National Environmental Policy (NEP), National Climate Change Management Policy (NCCMP) and the National Climate Change Investment Plan (NCCIP) (GoM, 2013).

Changing climate has made disasters frequent in Malawi and other surrounding countries. ***The National Disaster Risk Management Policy of 2015*** policy, whose main goal is to sustainably reduce disaster losses in lives and socio-economic and environmental assets of individuals, communities and the nation, is critical (GoM, 2015b). The vision of the NDRM Policy is 'a Nation resilient to disasters. "*The long-term goal for disaster risk management in Malawi is to sustainably reduce disaster losses in lives and the social, economic and environmental assets of individuals, communities and the nation."* A comprehensive system for disaster risk identification, assessment and monitoring were prioritized. The policy aimed to ensure that disaster risk reduction strategies are mainstreamed in sector policies, plans, and budgets at all levels; resilience of communities to disasters is increased and improved preparedness is attained for an effective response to and recovery from disasters. The culture of safety and adoption of resilience-enhancing interventions was also promoted through interdisciplinary and policy-oriented research on appropriate disaster risk management technologies and approaches. The redress of underlying risks will be undertaken through the promotion of sustainable and long-term community-based disaster risk reduction measures; good land use planning; construction of resilient infrastructure; and the strengthening of preparedness capacity for effective response and recovery.

The National Disaster Recovery Framework (NDRF) of 2017 was designed in alignment with Malawi's national disaster risk management and recovery policies and strategies. It serves both

strategic and operational purposes in the management of a disaster recovery programme. The NDRF was developed in response to the 2015 floods and has evolved to also guide 2015/16 drought recovery efforts under a common framework, providing oversight to implementation and monitoring arrangements. The Vision of NDRF (GoM, 2017b) is "*A nation that is food secure and resilient to natural disasters that can rapidly recover from drought and flood shocks while fostering sustainable economic growth and ensuring equitable, inclusive, and participatory reconstruction that builds back better."* The Goal of NDRF is **"***to sustainably improve the resilience of communities affected by the floods and drought, support prolonged food security of vulnerable populations, and restore the livelihoods of disaster-affected communities."* The NDRF was developed in conformity with national legislation, policies, and strategies and aligns with all Malawi statutes governing or supporting disaster risk management and recovery and all sector and thematic legislation policies and strategies with which disaster recovery is associated. This is consistent with the concept of Eco-innovation.

The National Meteorological Policy (NMP) of 2019 was developed to contribute towards the enhancement of meteorological services to support the socio-economic development of Malawi. The policy prioritizes seven issues: monitoring and prediction of weather and climate; management of meteorological data and information; Meteorological Engineering and Information Technology (IT) development; meteorological research services; financing the climate change and meteorological sector; capacity building and awareness; and cross-cutting issues (GoM, 2019). In 2016, Malawi developed various policy frameworks including the climate change policy guidance that provides broad and long-term scale. The climate change policy and other policies· are silent on growth and development of in the meteorological sector· Therefore providing limited room for action, especially, at the local community level. Therefore, the country developed this National Meteorological Policy to "address 'shortfalls' in the climate change policy and other relevant policies." The NMP will complement and strengthen the operationalization of the climate change policy. It will assist Malawi to contribute to international discourse on weather and climate, as well as benefit from services offered by relevant international, organizations to which· Malawi is affiliated, through the· DCCMS. The practical nature of this policy to directly intervene in case of weather disaster makes it proactive and thus responsive to the needs of the people in line with Eco-innovative principles. The relevant institutions active in the Environment sector in Ghana are included in Table 22 below.

Table 22: Eco-innovation relevant Institutions and actors in the Environment and Natural Resources Sector-Malawi

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Natural Resources, Energy and Environment	The Ministry of Natural Resources, Energy and Environment is mandated to provide policy guidance and direction on all matters concerning Malawi's natural resources, energy, and environmental management.
National Council for Environment (NCE)	NCE is a high-level body comprising the Secretary to the President and Cabinet, principal secretaries of all ministries and heads of relevant parastatal agencies and the private sector and NGOs.
Technical Committee on Environment (TCE)	TCE is a group of experts whose functions are to examine scientific issues and undertake investigations into scientific, social and economic aspects of any activity and recommend to the Minister,

	NCE or any lead agency such action as is necessary to achieve the objectives of the Act.
District Assemblies	District Assemblies formerly District Development Committee (DDC) are empowered to coordinate the activities of NGOs and lead agencies in environmental issues at the district level. The DDCs were replaced by district assemblies under the National Decentralization Policy Local Government Act 1998.
Malawi Bureau of Standards (MBS)	MBS promotes metrology, standardization and quality assurance of commodities and of the manufacture, production, processing or treatment thereof; and further provide for matters incidental to, or connected with standardization.
Ministries, Departments, and Agencies (MDAs)	MDAs are responsible for defining prioritized sector recovery frameworks and for overseeing the implementation of recovery interventions in their sectors. The identification of local recovery projects will be led by DCs and local government, while MDAs will guide resource allocations for recovery through annual budget allocations, as well as by directing financial assistance provided by development partners (DPs) and non-governmental organisations (NGOs) to priority sector recovery interventions.
National Disaster Preparedness and Relief Committee (NDPRC)	Provides the central oversight of the NDRF
The National Disaster Preparedness and Relief Technical Committee (NDPRTC)	NDPRTC responsible for inter-cluster coordination, and plays an important role in ensuring multi-stakeholder engagement for the development and review of NDRF activities across sectors.
National Steering Committee on Climate Change	The NSCCC provides a forum for effective policy dialogue on frameworks, priority setting, and ways and means of facilitating investment and transfer of technology on climate change initiatives in the country. The two committees are permanent national climate change committees.
National Technical Committee on Climate Change (NTCCC)	NTCCC provides an institutional framework for national and international cooperation; embracing a holistic approach to climate change interventions toward the development of adaptation and mitigation initiatives through partnerships between government agencies, the private sector, NGOs, CBOs, academia and local communities.
Department of Disaster Management Affairs (DoDMA)	DoDMA is a Government agency in the Office of the President and Cabinet that is mandated to coordinate and oversee disaster risk management programs and projects being implemented by various stakeholders in the country to build and improve the resilience of households, communities and the nation to disaster risks. The Department was established in 1994 by the DPR Act (1991), which was enacted after the Phalombe floods catastrophe to coordinate and implement measures to alleviate the effects of disasters.

Department of Water Resources (DWR)	DWR is mandated to monitor the country's surface water resources and one of its core activities is to issue early warnings of impending floods. Based on Rainfall Forecast from the Department of Climate Change and Meteorological Services (DCCMS) and water levels from the National Hydrological Monitoring Network installed across the country, as well as from the Operational Decision Support System (DDSS) if a flood alert has been forecasted.
Department of Climate Change and Meteorological Services (DCCMS)	• To monitor, analyse and predict weather and climate. The thrust of this objective is to ensure that the weather forecast is produced for early warning purposes. This information is vital for advisory in natural disaster early warnings. • To provide weather and climate data and information for various socio-economic sectors such as Aviation, Agriculture, Water, Marine, Construction industry, insurance, Tourism, Health, sports and Recreation. • To carry out research and development that would improve the quality of weather and climate data and information for the general public. The main focus is to research all aspects of meteorology inter alia the general public through mass media. • To establish and maintain a well-equipped network of Met stations. This Objective intends to ensure that meteorological data and information is reliable, timely and up to date.

3.5.5 Eco-innovation related Policies and Frameworks in the Agriculture Sector- Malawi

Agriculture forms the basis of the Malawian economy. It represents over 38% of GDP and employs over 85% of the labour force. Unfortunately, the agriculture sector faces a litany of challenges: small landholdings, a poorly developed seed sector, weak agricultural extension services, limited access to finance, uncertainty due to climate change, significant policy constraints, and meagre irrigation infrastructure meaning a near-total dependence upon timely and sufficient rains. Climatic and world price fluctuations of Malawi's few cash crops for export (tobacco, tea, cotton, etc.) expose families and the economy to external shocks which can undermine economic growth. Partly as a result of these challenges, 70% of the population of Malawi lives below the poverty line. Through partnerships with the Government of Malawi, local and international non-governmental organizations, and the private sector, USAID is spearheading innovative programs to strengthen smallholder farmers' economic and climatic resiliency.

Malawi remains an agro-based economy and it will be so for the next few years. The sector is characterised by rain-fed subsistence farming, smallholder farming and traditional ways of farming, which leave a lot of people vulnerable to food shortages in times of shocks such as price fluctuation and weather variations. The Sector has focused on mechanized large-scale commercial farming complemented with agro-processing, value addition and manufacturing to mitigate the impact of climate change that has negatively affected agricultural productivity in recent years, as well as on the promotion of adaptive technologies and strategies and/or mitigation programmes. Also, environmental management and conservation and climate-smart agriculture technologies are being promoted.

The National Agriculture Policy (NAP) of 2016 was developed to provide clear and comprehensive policy guidance in agriculture. This policy framework attempted to address the challenges facing the sector in Malawi. The specific objective of the NAP is to guide Malawi to achieve the transformation of the agriculture sector. More specifically, this policy guides us towards increasing production, productivity, and real farm incomes. The emphasis of this policy is on achieving farmer-led agricultural transformation and commercialization that entails treating farming as a business. The policy will facilitate and harness dynamic transitions taking place within farming communities, in particular, the movement of farming households into non-traditional high-value agricultural value chains and increased engagement in profitable off-farm and non-agricultural livelihoods (GoM, 2016b). Through the implementation of the NAP, the government of Malawi intends to create a conducive environment for sustained growth in the agricultural sector. The NAP seeks to transform the motivation for engagement in agricultural production by Malawian farmers from simply being the primary means by which they secure their basic livelihood but also by engaging more in commercialized agriculture, wealth creation becomes the motivation. The policy focuses on sustainability in terms of food production and irrigation. It also aims at encouraging youth, women and vulnerable groups to engage in agricultural activities by stimulating business ventures in the sector through value addition and promoting agribusiness ventures. The NAP emphasizes on promoting stakeholder coordination in all matters relating to the sector.

The National Irrigation Policy (NIP) of 2016 aims at addressing critical issues affecting the irrigation sector that include spatial and temporal water shortages; customary land tenure disputes; and, poor operation and maintenance of infrastructure. The NIP attempts to provide solutions to these challenges by addressing three priority areas of sustainable irrigation development, management and capacity development. The policy acknowledges several opportunities that exist for accelerated irrigation development, namely; effects of climate change, public-private partnerships, improved governance reforms in water and land management, and increasing interest by stakeholders. The Policy is well anchored in the National Water Policy, Agriculture Policy, National Environmental Policy and others. The NIP emphasizes that irrigation development and management should serve human needs such as food, nutrition and income (GoM, 2016c). It further strives to ensure that the environment is given due consideration in all irrigation developments.

The Livestock Policy of 2004 was developed to increase the availability of quality livestock and livestock products by promoting local production. It will, therefore, contribute to national development objectives aimed at poverty reduction, improving rural livelihoods and relates to the empowerment of producers and the welfare of consumers and conservation of the environment through the provision of animal husbandry, health and public health services. The goal of this policy strongly conforms to the principles of Eco-innovation and thus its promotion. The actors in the Agriculture Sector in Malawi are provided in Table 23.

Table 23: Eco-innovation relevant Institutions and actors in the Agriculture Sector- Malawi

Name of institution/ Actor	Roles played in Eco-innovation
Ministry of Agriculture, Irrigation and Water Development (MoAIWD)	MoAIWD fosters sector-wide planning, management and coordination in the agriculture sector; make prudent public investments in the agriculture sector; Ensure efficient delivery of services in agriculture; Support innovative evidence-based modifications to agricultural subsidy programmes that will make them sustainable and efficient; support efforts to encourage smallholder farmers to use improved seeds, irrigation, integrated soil fertility management techniques, and other modern farm technologies; Provide platforms for healthy agriculture policy dialogue and actively engage in consultative policy processes in the formulation, planning, and implementation of sub-sectoral policies and strategies; promote decentralization of decision-making in the agricultural sector from the central to district and Extension Planning Area (EPA) levels; and support building the capacity of district and EPA-level institutions.
Ministry of Finance, Economic Planning and Development	Maintain sound macro-economic conditions; Mobilize resources; Allocate public funds from the national treasury to the agriculture sector; Create tax-related incentives that encourage private sector investments in agriculture to help increase smallholder farm incomes; Promote access to finance for agriculture; Facilitate preparation of agricultural-related statistics and information for policy planning and implementation.
Ministry of Industry and Trade	Facilitate foreign direct investment; Identify new export markets and promote Malawian agricultural products; Facilitate agribusiness licensing and improve the ease of doing business in agriculture; Facilitate the establishment and enforcement of quality standards for agricultural products, particularly through the Malawi Bureau of Standards; Promote transparent and predictable export and import controls, particularly in minimizing any non-tariff barriers to agricultural trade; Involve the Ministry responsible for Agriculture, Irrigation and Water Development and stakeholders in agriculture in the formation, training, and registration of agricultural cooperatives; Facilitate public-private partnership along agricultural value chains.
Ministry of Lands	Promote proper use of agriculture land in collaboration with the Ministry responsible for Agriculture, Irrigation and Water Development; Promote land tenure security; Identify land for investments in agriculture, including land with irrigation potential.
Ministry Responsible for Parks and Wildlife	The role of the Ministry shall be to: Promote conservation of catchment areas in Game Reserves and parks to ensure acceptable water quality and adequate quantities that can be used for irrigation; and ensure that in any review of the status of protected areas, irrigated agriculture should be included as one of the options for future development and utilization of such land. c. Devise ways of preventing the invasion of wildlife to irrigated lands.

Ministry responsible for Natural Resources and Energy	Facilitate the provision of adequate, reliable and affordable electricity for agricultural enterprises; Facilitate fuel supply for agriculture and agribusiness enterprises; Promote sustainable management of land and natural resources, in collaboration with the Ministry responsible for Agriculture, Irrigation and Water Development.
Ministry responsible for Transport and Public Works	Promote the development of main, secondary and tertiary roads to connect areas of high agricultural potential with major markets; Develop the railway system and lake and river transportation for agricultural products.
Ministry responsible for Local Government and Rural Development	Implement integrated rural development programmes for investment in rural infrastructure for agriculture; Promote development of the district and rural roads in areas of high agricultural potential; Promote the development of rural growth centres that support agriculture; Spearhead the implementation of the National Decentralisation Policy and Act.
Ministry responsible for Gender, Social Welfare and Disabilities	Ensure that gender is mainstreamed in agricultural programmes; Promote the production and utilisation of nutritious crops; Encourage the mainstreaming of nutrition and HIV/AIDS in all sectors, including agriculture; Collaborate with the Ministry responsible for Agriculture, Irrigation and Water Development to facilitate women's access to productive assets for agriculture and increased access to credit, and farm inputs; Support increased farm and agribusiness investments by women and vulnerable groups; Enable women's and vulnerable groups' access to lucrative output markets.
The National Food Reserve Agency	Will place strategic quantities grains, as a means of managing national food insecurity risks using a transparent, rules-based market operations approach; professionally maintain its storage infrastructure and improve its efficiency in delivering food security risk management to the nation.
National Commission for Science and Technology (NCST)	The role of NCST will be to support the irrigation sector in the generation of irrigation technologies for sustainable irrigation development and management.
Malawi Irrigation Board (MIB)	The roles and responsibilities of the MIB shall be to: a) Monitor the progress of irrigation development and management at the national level in compliance with irrigation standards and guidelines; and b) Ensure that irrigation development programmes are in line with national demands and priorities and that companies or individuals involved in irrigation development are suitably qualified and registered to ensure the sustainability and accountability of services provided. c) Manage the Irrigation Fund.
Malawi Committee on Irrigation and Drainage (MALCID)	The role of MALCID shall be to provide a forum for the exchange of ideas in irrigation development within Malawi. MALCID shall be affiliated with the International Commission on Irrigation and Drainage (ICID) for ease of accessing irrigation technologies.

National Water Resources Authority (NWRA)	The Water Resources Act of 2013 provides for the establishment of the National Water Resources Authority (NWRA). The main objective of the NWRA is to create an independent quasi-government organization that is a principal source of policy, control and protect (i.e., manage) the country's water resources. NWRA shall be responsible for reviewing applications and issuing of water rights. It shall also monitor water abstractions and effluent discharges.
The Smallholder Farmers Fertilizer Revolving Fund	Will facilitate affordable access to farm inputs for smallholder farmers, including through the use of farmer credit schemes.
The Malawi Bureau of Standards	Will be responsible for maintaining and enforcing product quality and food safety standards and ensuring quality standards for agricultural commodity storage.
Trusts	Including the Agricultural Research and Extension Trust (ARET), the Smallholder Coffee Growers Trust, the Roots and Tubers Crops Development Trust, the Legume Development Trust, among others, will continue to provide technical support on agricultural research and extension for the development of agricultural value chains.
Commodity Councils	Such as the Cotton Council, the Legumes Council, etc., will promote production and marketing support to increase commercialisation of the respective commodities under their mandate.
National Irrigation Board	The National Irrigation Board shall advise the Government and other stakeholders on policy matters relating to irrigation and drainage and shall also, among other things, approve standards and guidelines for the development and management of irrigation and drainage.
The National Irrigation Fund	Managed by the National Irrigation Board will also be used as a vehicle to increase irrigation investments.
Roads Fund Administration	Mobilises and administers resources for financing the development and rehabilitation of public roads in areas of high agricultural potential.
Malawi Roads Authority	Ensures that public roads are constructed.
Farmer-Based Organisations	Existing farmer organisations, such as the Farmers Union of Malawi (FUM) and the National Smallholder Farmers' Association of Malawi (NASFAM) and other similar organisations will spearhead the strengthening and organizing of farmers into groups for increased commercialisation and value addition. Farmer-based Organisations will enable improved access and more profitable engagement by farmers with farm input markets, credit and extension services, and output markets, including lucrative export markets. Farmer-based organisations will also play a critical role in empowering women, youth and vulnerable groups to engage in profitable entrepreneurial agribusinesses.
Private Sector Investors and Partnerships	Investments in market-based expansion and promotion of smallholder commercialisation. Public-private partnerships and domestic-foreign private partnerships and other organizational arrangements will be used to foster foreign direct investments into agriculture.

Civil Society	Collaborate with the Government in implementing programmes to ensure there is mutual accountability. Civil society organisations, such as the Civil Society Agriculture Network (CISANET), will play a key role in implementing the NAP through NGO projects and advocacy efforts. The Council for Non-Governmental Organisations in Malawi will be encouraged to engage with the government to support the implementation of the NAP and to help strengthen the voice and capacity of civil society organisations in agriculture.
Academic Institutions and Research Organisations	Responsible for conducting rigorous research in agriculture or related fields to enhance the impact of the NAP. In particular, researchers will research technologies that are suitable for application in Malawian agriculture. Resources and expertise to conduct the necessary research will be leveraged from other research organisations and institutions, such as the CGIAR centres, universities outside Malawi and several think tanks, both domestic and international, to the benefit of the agriculture sector in Malawi.
Development Partners	Support the NAP implementation based on the priority areas specified in the NAP. Development partner efforts in agriculture will also be coordinated and aligned with the efforts of other stakeholders to ensure synergy and effective investments in agriculture to achieve the goals of the NAP.

3.5.6 Eco-innovation related Policies and Frameworks in the Trade and Industry Sector-Malawi

Trade has for a long time been an integral part of Malawi's economy, dating back to the colonial era. Following the establishment of a British Protectorate in Nyasaland in the 1890s, European companies and individuals established estates in Nyasaland to produce and export coffee. The major objective of the British was then to replace the slave trade with 'legitimate' trade. As world coffee prices collapsed at the turn of the century, the settlers turned their attention to the production and exportation of cotton, tea and tobacco using the indigenous population as labour (WTO, 2004). The country's commercial policy focused mainly on the promotion of agriculture in terms of production and trade.

The policy relating to trade and industry in Malawi was embodied in two policy documents, namely the MGDS and the Integrated Trade and Industry Policy which was adopted in 1998. The goal of the Integrated Trade and Industry Policy is "to create a conducive environment in which the performance of the private sector will be efficient and market-oriented, improving its competitiveness domestically and internationally to ensure the sector's maximum contribution to the achievement of overall social-economic objectives." The policy document integrated trade and industry to ensure complementarity between trade and industry policies. (Ministry of Industry and Trade, 1998). The Policy's mission statement summarises the gist of the policy which is stated as "to promote, support, and facilitate private enterprise efforts to make Malawi a manufacturing-based economy, capable of creating and sustaining a competitive advantage in domestic and international markets and to support effective participation of Malawians in the trade and industry sectors." This policy has since been split into two policies covering Trade and Industry separately.

The National Trade Policy of 2016 seeks to drive the structural transformation of the productive sector through supporting and managing domestic market structure integration in regional and global markets as well as value chains with the ambition of increasing exports. The goal of the National Trade Policy is to make Malawi a globally competitive export-oriented economy, generating higher and sustainable livelihoods through trade that recognises the role of Macro, Small and Medium Enterprises (MSMEs) and the vulnerable groups. It aims to achieve this goal by driving the structural transformation of the productive sector and supporting and managing domestic market structure and integration in regional and global markets through value chains with the ambition of increasing exports. It guides in dealing with factors that determine the growth of the economy such as land, taxes, productive labour force, energy supply, raw materials, transport costs, and education standards (GoM, 2016d).

The National Industrial Policy of 2016 has been developed in recognition that industrialization and structural transformation of the economy is essential to maintain a rapid long-term economic growth that is needed to raise per capita income, create sufficient rural and urban jobs, widen the tax base to finance Malawi's welfare requirements and address an unsustainable trade deficit (GoM, 2016e). It addresses issues such as appropriate skills and technology; improved business environment for the manufacturing sector; improved access to key business services; support to the manufacturing sector and increased participation of the MSMEs.

The Malawi National Export Strategy (NES) 2013-2018 is the first strategy that Malawian stakeholders have developed that takes the country's ability to export as its overarching objective. The aim is to permanently develop Malawi's capacity to export, such that the goals and ambitions set out in the MGDS II may be achieved. The NES also hoped to promote local industries and local production to increase export and trade. The NES focuses on three product clusters namely oilseed products, sugarcane products and manufacturers (GoM, 2013b). These products have the potential of complementing tobacco and driving exports through value addition in a manner that exports can outpace the growth of imports.

Table 24: Eco-innovation relevant Institutions and actors in the Trade and Industry Sector-Malawi

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Industry, Trade and Tourism	It is the lead institution for the implementation of trade that provides leadership for this policy. However, it shall endeavour to engage with all key stakeholders in the policy process and cycle. The Ministry will continue to engage with stakeholders through the National Working Group on Trade policy, the Trade, Industry, and Private Sector Development Sector-Wide Approach (TIPSWAp) implementation framework, and the Inter-Ministerial Committee on Trade.

3.5.7 Eco-innovation related Policies and Frameworks in the Transport and Infrastructure Sector-Malawi

Malawi has a multi-modal transportation system consisting of road, rail, air and inland water transport. Most of the infrastructure in these four modes of transport forms part of one or more of the international corridors used for the transportation of international freight for the country. The cost of doing business in Malawi is high largely due to high transport costs resulting

from poor roads and the absence of alternative transport modes. Upon development of the road network and other transport facilities, Malawi is expected to become a cheap destination for business, making Malawi competitive and attractive to investors. The feeder roads are crucial if the provision of social services including schools, health facilities and markets improve. Also, the Nacala railway, which was instrumental in moving humanitarian relief supplies during the period the country was hit by calamities, will ease the movement of goods and people. Below we explore some of the national policies that address the transport sector in Malawi.

The Government revised ***the 2015 National Transport Policy*** to provide a new policy direction and guidance to all stakeholders in the implementation of interventions in the transport sector (GoM, 2015c). This was necessary for the development of the transport sector as directed by MGDS III and SDGs. ***The National Transport Policy of 2019*** builds on the ***National Transport Master Plan (NTMP) 2017 to 2037*** and the adopted institutional reforms, which in particular, involves further institutional separation of policymaking, (autonomous) regulation and (commercialised, concession or privatised) transport network ownership, operation and service provision. The Policy, along with its accompanying Implementation Plan, is a significant advancement in the development of the transport sector in Malawi. This will ensure the development of a coordinated and efficient transport infrastructure that will foster a safe and competitive operation of viable, affordable, equitable and sustainable transport services. The implementation of the policy will produce the following expected outcomes: reduced travel time and transport costs for persons and goods; enhanced access to inputs; improved access to local and international product markets; and improved access to social and public services for the urban and rural population.

The National Transport Master Plan (NTMP) 2017-2037, provides a clear framework for delivering sustainable interventions to enhance the transport sector across Malawi for the period between 2017 and 2037. The national strategy will, however, concentrate on the construction and rehabilitation of roads and railway transport infrastructure so that the mobility of goods and passengers is made easy (GoM, 2017c). High transport costs are an inhibitor to both international trade and domestic freight, and as a landlocked country, Malawi relies heavily on road transport, a fact which contributes towards persistently high transport costs. The impact of the proposed interventions promotes a strategic modal shift from road to rail and inland water transport, where larger quantities of cargo can be moved at a lower cost. The master plan places a heavy emphasis on safety issues and seeks to address them for every transport sub-sector. The road sub-sector addresses the issue from the grass route level through schemes like raising awareness and improving driving skills. The NTMP proposes to promote international safety standards for the design and operation of all modes. The plan also proposes several institutional changes, including the establishment of a National Road Safety Authority. The measures set out in the NTMP have focused on a core principle of increasing sustainability in the transport sector. The NTMP, as a whole, will have positive environmental and social impacts in terms of improving and strengthening regulatory structures and policy and providing a clear direction for future planning, development, monitoring and enforcement[17]. These augers well with the various elements of Eco-innovation. The measures proposed, including upgrading, maintenance and new developments,

[17] https://www.malawi.gov.mw/images/Publications/NTMP_Final_Documents/Final_Report_Summary/NTMP_Final_Report_Executive_Summary.pdf

have the potential to improve efficiency, connectivity, access and equity. The actions have been considered in the context of impacts on social dimensions including gender, income, mobility and age. They collectively meet the needs of diverse social groups, and infrastructural, institutional and regulatory measures are proposed to design these considerations into the transport sector planning and operation in the long term. The various roles and responsibilities within Malawi's transport sector are distributed across a range of public bodies and private sector organisations at the national and local level. MoTPW is the principal steward of the multi-modal transport system, its policies, and regulations. Along with MoTPW's agencies and departments, other external agencies involved in the planning and operation of the transport sector in Malawi include development partners, district and city councils and private sector or concessioners.

Table 25: Institutions supporting Eco-innovation under the Transport Sector in Malawi

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Transport and Public Works (MoTPW)	MoTPW is the custodian of the overall transport sector policy development through its key departments namely: Roads Department, Rail Transport Services, Road Traffic and Safety Services, Marine Services, Civil Aviation, Building Department and Transport Planning.

3.5.8 Eco-innovation related Policies and Frameworks in the Science, Technology and Innovation Sector-Malawi

Despite being one of the poorest countries in the world, Malawi spends 1% of its GDP on R&D, one of the highest ratios in Africa, even if R&D spending remains low in real terms. Malawi thus has the potential to harness STI to reducing poverty and diversifying its agriculture-dependent economy. The challenge is to attract sufficient Foreign Direct Investment (FDI) to foster technology transfer and empower the private sector to serve as an engine of economic growth (Lemarchand and Schneegans, 2014). The government has recently begun reforming its financial management system and has put a series of fiscal incentives in place to attract foreign investors. The country has also introduced a series of policy instruments to promote FDI, including tax incentives and the Malawi Innovation Challenge Fund for private businesses, which nurtures productive partnerships between leading firms and poor producers and entrepreneurs. The Malawi Innovation Hub has enhanced STI in Malawi (See Box 7).

The adoption of the ***National Export Strategy of 2013,*** by the GoM, was meant to diversify the country's exports. Production facilities were to be established for a wide range of products within the three selected clusters: oilseed products, sugar cane products and manufacturing. The government estimates that these three clusters have the potential to represent more than 50% of Malawi's exports by 2027. To help companies adopt innovative practices and technologies, the strategy provided for greater access to the outcome of international research and better information about available technologies; it also helps companies to obtain grants to invest in such technologies from sources such as the country's Export Development Fund (Kraemer-Mbula and Scerri, 2015) and the Malawi Innovation Challenge Fund [Box 8] (Lemarchand and Schneegans, 2014). The strategy does not, however, mention any support for Eco-innovation or enhance the principle of environmental sustainability.

Box 7: Eco-Innovation Related Institutions: The Malawi Innovation Hub

The Malawi Innovation Hub really embrace the tremendous improvement on the science technology and innovation in Malawi more so in the line of agricultural innovation. The invention of utility of drone in the field of agriculture and environment has scaled up eco innovation related activities. Innovators and those running tech hubs said that with little to no support from banks, the government and Telcos, tech start-ups in Malawi are turning to non-governmental organisations for support and incubation. "There is no such thing in Malawi to support start-ups (from the government). Only those associated with the government can get the support," said Misael Stephen Buliani from the Innovation Hub Malawi. Buliani added that a lack of funding, resources and operating centres (such as start-up spaces) are holding tech start-ups back. "Tech start-ups from Malawi have one major aim - to help the innovation and assist with employment in the tech sector. "The Innovation Hub Malawi receives funding and support from UNICEF and other environmental bodies supporters, which is involved in various tech-focused initiatives, including mapping.

http://www.mhubmw.com/

Box 8: Malawi Innovation Challenge Fund

The Malawi Innovation Challenge Fund is a competitive facility, through which businesses in Malawi's agricultural and manufacturing sectors can apply for grant funding for innovative projects with potential for making a strong social impact and helping the country to diversify its narrow range of exports. These funds enable innovative projects to get incubated and reach the implementation stage. The MICF Irrigation Window aims to introduce new initiatives that deliver new products, services and business models that link smallholder producers to markets by increasing the production of crops under irrigation, leading to viable self-financed cultivation of irrigated crops under well maintained environmental effect check-up.

https://www.micf.mw/

Malawi has, under the ***National Science and Technology Policy (NSTP) of 2002,*** set for herself principles through which the country will discipline her development by utilizing her human resources. This policy put in place strategies that will enable the country to achieve a technology-based development. The promulgation of this policy underscores the important role Malawi attaches to the development and application of science and technology in national socio-economic development. The overall goal of the NSTP is to attain sustainable socio-economic development through the development and application of science and technology to improve the standard and quality of life of Malawians (GoM, 2002). This policy, however, is still under review and does not address the current challenges and needs to be aligned to the national development plans and policies.

The National Information and Communications Technology Policy of 2013 was developed by the Government of Malawi to give direction on ICT development in the country. The ICT Policy will support the national goal of wealth creation and reduction of poverty through sustainable economic growth and infrastructure development. The policy is providing a framework for deployment, exploitation and development of ICT to support the process of accelerated socio-

economic development in Malawi. The government will provide direction for systematic ICT program development, implementation, monitoring and review through this policy. It also aims at consolidating an ICT approach for the mobilization, allocation and utilization of resources to realize institutional, community, sector and national development policies and strategies (GoM, 2013c). This Policy covers Information Technology (IT), Telecommunications, Broadcasting and Postal services. The ICT Policy aims at guiding: provision of ICT services in the rural areas and to the vulnerable groups; investment in priority ICT areas; the Public Sector in the planning for the national development and utilization of ICT; and the formulation of an appropriate regulatory and legal framework aimed at safeguarding fundamental human rights, protecting privacy, promoting electronic services, and promoting competition in the ICT sector. Good ICT infrastructure is also important in improving communication and broadcasting services. In this era of technology, the development of ICT infrastructure is paramount in promoting trade and investment. ICT is also playing a catalytic role in the provision of social services such as health and education. In this regard, the government will work towards improving the ICT infrastructure to create a conducive environment for private sector development. Information and Communication Technology is a new and emerging sector in Malawi due to its pivotal nature in accelerating economic growth and as an enabler for poverty reduction and wealth creation. Some of the strategies that will be implemented to achieve the goals include creating a conducive environment to attract investment in ICT infrastructure and services; developing a reliable, fast, adaptive and robust national ICT infrastructure that feeds into international networks; intensifying ICT education and training in all sectors; improving ICT access by all communities; and developing monitoring and evaluation tools and techniques for the sector.

The National Intellectual Property Policy of 2019 is part of the Malawian government's Growth and Development Strategy III, which has identified industrialisation and the structural transformation of the economy as a key priority area essential to maintaining long-term growth and economic development. The Policy acknowledges that intellectual property has effectively been side-lined from the national development agenda since Malawi's independence, recognises that intellectual property is a catalyst for technologic advancement, economic growth and national development and provides a framework to foster the generation, protection and exploitation of intellectual property. While Malawi does have intellectual property laws, these laws (with the exception of the "new" Trademarks Act No. 28 of 2017 and Copyright Act No. 26 of 2016) were inherited from its former colonial power, the United Kingdom, and are outdated. Intellectual property is also administered by two separate institutions – industrial property (which includes patents, designs and trademarks) is administered by the Department of the Registrar General which falls under the Ministry of Justice while copyright is administered by the Copyright Society of Malawi which falls under the Ministry responsible for Culture.

The National Radiology Policy (NRP) of 2020 provides a unified guiding framework for achieving quality and standardized radiological services in the country. The policy aims to improve the functioning of radiological services by addressing identified key challenges and their root causes. Radiology services in Malawi are faced with challenges such as poor infrastructure, inadequate equipment, inadequate funding, weak partner coordination, low staff development and non-existent or uncoordinated standards of operation. To achieve its objectives, the policy has prioritised five key areas of focus and are capacity building and service delivery; infrastructure and equipment; Health and Radiology Safety; Quality Assurance; and Research and Data

management. Unfortunately, environmental sustainability or Eco-innovation are not mentioned or recognized in the policy. The key actors and their role in the STI sector in Malawi have been provided in Table 26.

Table 26: Eco-innovation relevant Institutions and actors in the Science Technology and Innovation Sector- Malawi

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Education, Science and Technology	The Ministry of Education, Science and Technology is the custodian of Malawi's Education Sector as well as all matters relating to Science and Technology. The Ministry is the Government arm that is responsible for providing policy guidance and direction on all education, science and technology issues. The Department of S&T functions include: • Formulate and review policies and the legal framework in the field of Science, Technology and Innovation (STI); • Act as a focal point for developing and maintaining international cooperation in STI; • Act as a link between national S&T institutions and the responsible Ministry; • Provide national policy guidance and direction on all STI and Research and Development matters in Malawi.
National Commission for Science and Technology Malawi (NCST)	The NCST is established by the Science and Technology Act No.16 of 2003 with the principal function to advise the Government and other stakeholders on all science and technology matters to achieve a science and technology-led development. The role of NCST is, thus, one of coordination and provision of advice. The NCST is governed by a Board of fifteen Commissioners appointed according to this Act. NCST promotes, supports, coordinates and regulates the development and application of research, science, technology and innovation to create wealth to improve the quality of life.
Centre for Innovation and Industrial Research (CIIR)	The strategic goal of CIIR is to advance STI through quality research, capacity development, application and commercialisation of outputs. The CIIR is moulded on the understanding that advancing development for the individual, the community and the nation requires the systematic investment in innovation and innovativeness from the vast resources bank within Malawi University of Science and Technology (MUST) and beyond MUST's borders. As such, the CIIR takes a keen interest in seeking, developing and advancing innovative ideas through relevant industrial research.
Ministry of Justice, Ministry of Culture, Ministry of Industry, Trade and Tourism, Malawi Police,	Under the new IP Policy, these institutions would be required to set standards on IP service delivery, inspect and ensure the delivery of original and genuine materials, advise institutions and stakeholders on IP issues, mediate and arbitrate IP related disputes; and prevent smuggling of counterfeit products.

Malawi Revenue Authority, Malawi bureau of standards	

3.5.9 What works, what doesn't work and why in Malawi

This section highlights some of the initiatives that have worked well in Malawi across different sectors in the development of Eco-innovation as well as initiatives that have not worked well and the reasons behind the successes or failures.

3.5.9.1 What works and why

a) Increased political support for environmental conservation and sustainability and mainstreaming in National Development Plans

Supporting policies and strategies: Malawi Growth and Development Strategy (MGDS), international conventions and treaties such as the Paris Agreement, CITES, National Environmental Policy (NEP) of 1996 revised in 2004, the Environment Management Act of 1996, the National Forestry Policy of 1996 and the Forestry Act of 1997, Wildlife Policy of 2000, the National Parks and Wildlife Amendment Act of 2004, the National Climate Change Management Policy (NCCMP) of 2016, Malawi's National Adaptation Plan Framework of 2020, Vision 2020, the SDGs and the Sendai Framework on Disaster Risk Reduction 2015-2030.

Description and impact*:* The President of Malawi declared that climate change, environment and natural resources to be one of the nine key priority areas for the MGDS. This major policy move was timely given the prevailing and emerging poverty/environment problems. Ratification of various International and Regional Environmental Conventions and Treaties by the government and the political class in Malawi have demonstrated commitment is supporting sustainable development through environmental conservation that is also a major source of revenue through eco-tourism and mining activities. This has also been demonstrated by the commitment shown in the ratification and implementation of major international treaties such as the Paris Agreement and many others. These policies have contributed immensely to the growing recognition of the need for environmental sustainability in Malawi. The CSOs and private sector are increasingly becoming aware of this as well and are supporting the measures being put in place by the government to ensure environmental sustainability.

Reasons for success:

- National, regional and international support for environmental conservation.
- Significant financial and technical support from Government and development partners.
- Increasing participation of non-governmental actors and the private sector.

b) The Poverty and Environment Initiative (PEI)

Supporting policies and strategies: Malawi Growth and Development Strategy (MGDS I., II and III), international conventions and treaties such as the Paris Agreement, CITES, National Environmental Policy (NEP) of 1996 revised in 2004, the Environment Management Act of 1996, and SADC Biodiversity Strategy of 2008.

Description and impact*:* PEI was initiated to improve the enabling conditions for integrating environmental/natural resource management with poverty reduction. As a catalytic activity, PEI is

not tackling the entire set of p/e mainstreaming needs itself, but focuses strategically, works with partners and informs other relevant works, such as current UK Government-supported work on climate change strategy. It supports the inclusion of poverty/environment issues in the Malawi Growth and Development Strategy and the national budget, with contributing work on economic case-making and improving government decision-making guidelines – all relatively top-down entry points for mainstreaming environment. But PEI also addressed tools such as p/e indicators for agriculture. With agriculture a key sector for the poor, this also opened PEI up to some bottom-up perspectives on mainstreaming too. As such, PEI was a catalyst not only for MGDS enrichment but also for mobilising and harmonising many of the mainstreaming initiatives. Increasingly, most strategies and plans always consider environmental issues alongside the economic development of the people to ensure sustainability.

Reasons for success:

- Strong international support both technically and financially
- Linkage to poverty eradication has attracted goodwill from the people and government as well as the private sector.

c) Implementation of various energy projects, policies and programmes

Supporting policies and strategies: The National Energy Policy of 2018, Renewable Energy Strategy of 2017, National Industrial Policy of 2016, Sustainable Energy for All Action Agenda of 2017 and the Malawi Integrated Resource Plan of 2017.

Description and impact*:* The National Energy Policy of 2018 and the Malawi Renewable Energy Strategy of 2017 build on the targets laid out in the Sustainable Energy for All Action Agenda of 2017 and provide high-level policy direction, complemented by the detailed technical analysis made available in the most recent Integrated Resource Plan of 2017. The Energy policy 2018 goal is to increase access to affordable, reliable, sustainable, efficient and modern energy for all Malawians. It will, among other things, enhance electricity generation and distribution to all those who need it for domestic and industrial use. To improve access to energy, the Government will continue to undertake rural electrification through the establishment of the Rural Electrification Agency as a semiautonomous legal entity to manage rural electrification activities, the Rural Electrification Fund and renewable energy activities. The Government is promoting the use of solar and other renewable energy sources in rural areas to reduce deforestation across the country. The National Industrial Policy of 2016 is also important in the implementation of MGDS III since it helps increase the proportion of manufacturing in GDP by enhancing the productivity of the sector.

Reasons for success:

- Multi-stakeholder involvement
- Firm anchorage in policy and institutional frameworks

d) Improving Energy, Trade, Industrial and Mining Human Resource and Infrastructure Capacity

Supporting policies and strategies: National Transport Policy of 2015, the National Transport Master Plan (NTMP) 2017-2037, National Industrial Policy of 2016, Energy Policy of 2018 and National Export Strategy of 2013.

Description and impact: The state of the infrastructure has a big impact on the cost of production and development and has prompted the government to improve road and telecommunication infrastructure. The most recent infrastructural project that has the potential to reduce the cost of importation and exportation of bulk products is the Shire-Zambezi Inland Port. The Government revised the 2015 National Transport Policy to provide a new policy direction and guidance to all stakeholders in the implementation of interventions in the transport sector. This was necessary for the development of the transport sector as directed by MGDS III and SDGs. The National Transport Policy of 2019 builds on the National Transport Master Plan (NTMP) 2017 to 2037 and the adopted institutional reforms, which in particular, involves further institutional separation of policymaking, (autonomous) regulation and (commercialised, concession or privatised) transport network ownership, operation and service provision. The implementation of the policy is expected to reduce travel time and transport costs for persons and goods; enhanced access to inputs; improved access to local and international product markets; and improved access to social and public services for the urban and rural population.

The adoption of the National Export Strategy in 2013 to diversify the country's exports has led to many gains: production facilities have been established for a wide range of products within the three selected clusters- oilseed products, sugar cane products and manufacturing. In order to help companies, adopt innovative practices and technologies, the strategy made provisions for greater access to the outcome of international research and better information about available technologies; it also helps companies to obtain grants to invest in such technologies from sources such as the country's Export Development Fund and the Malawi Innovation Challenge Fund.

Reasons for success:

- The development of policies has been followed up by the development of strategies and plans that have been derived from the national long-term plans.
- Provision of clear strategies and frameworks for implementation

e) Programme for Basic Energy and Conservation (ProBEC)

Supporting policies and Strategies: Energy policy of 2018, Renewable Energy Strategy of 2017, and SADC Regional Biodiversity and Energy Strategies.

Description and impact*:* The Programme for Basic Energy and Conservation (ProBEC) is a regional programme implemented by the German Agency for Technical Co-operation (GTZ) in the SADC region. ProBEC is a programme that manages and stimulates the establishment of various projects based on basic energy conservation in 10 member states in SADC. It was implemented in Malawi, Lesotho, Mozambique, Tanzania, Zambia and Zimbabwe. ProBEC promotes improved energy solutions through market development and policy support. ProBEC aims to ensure that low-income population groups satisfy their energy requirements in a socially and environmentally sustainable manner. It targets the thermal energy needs of rural and urban households, as well as small business and institutions using biomass energy (wood fuel, agricultural residues) for thermal processes. The results of ProBEC interventions have shown that with a comprehensive package of solutions, it is feasible to attain multiple, long-lasting, environmental, economic, and social benefits. Families and small businesses benefit financially from savings, health is improved through minimised indoor air pollution, nationally there are savings of foreign exchange for energy imports, and globally, the use of biofuels instead of fossil

fuels reduces net emissions of greenhouse gases, as well as optimising timber and non-timber forest products. Interventions focus on the demand side and include the use of energy-efficient devices, profitable production and marketing of these devices, efficient wood fuel use and kitchen management, and substitution with renewable energy sources.

Reasons for success:

- Pro-poor focussed and provision of affordable energy solutions.
- Involves communities in the development of energy solutions and implementation of the project.
- There was strong government and private sector support.
- Engagement in policy supportive actions such as assisting the formulation and enforcement of regulatory frameworks; supporting the development of basic energy strategies and operational plans with a pro-poor focus; and improving coordination amongst key stakeholders.
- The establishment of a National Advisory Group in each country, consisting of government, NGO, private sector and others in the energy field.

f) Development of STI and ICT infrastructure and supporting institutions

Supporting policies and strategies: The National Science and Technology Policy (NSTP) of 2002, the National Information and Communications Technology Policy of 2013, ICT Policy of 2013 and the National Intellectual Property Policy of 2019.

Description and impact*:* The implementation of the national policies for STI has led to the establishment of the Malawi University of Science and Technology and the Lilongwe University of Agriculture and Natural Resources to build STI capacity. Other achievements include Biomedical research capacity improvement through the five-year Health Research Capacity Strengthening Initiative (2008-2013) awarding research grants and competitive scholarships at PhD, master's and first-degree levels, supported by the UK Wellcome Trust and DfID; strides made in conducting cotton confined field trials, with support from the US Program for Biosafety Systems, Monsanto and LUANAR; introduction of ethanol fuel as an alternative fuel to petrol and the adoption of ethanol technology; launch of the ICT Policy in 2013, to drive the deployment of ICTs in all economic and productive sectors and improve ICT infrastructure in rural areas, especially via the establishment of telecentres; and review of secondary school curricula in 2013. All these are actions in the right direction to support and mainstream Eco-innovation.

The establishment of the Innovation Challenge Fund is a clear positive step in the development of Eco-innovation. Businesses in Malawi's agricultural and manufacturing sectors can now apply for grant funding for innovative projects with the potential for making a strong social impact and helping the country to diversify its narrow range of exports. It provides a matching grant of up to 50% to innovative business projects to help absorb some of the commercial risks in triggering innovation. This has attracted support from the United Nations Development Programme, the UK Department for International Development among others.

The development of the National Intellectual Property Policy of 2019 aims to address the deficiencies created by these outdated intellectual property laws and the antiquated institutions that administer and manage them, as well as the lack of deliberate and coordinated policies aimed at

leveraging the intellectual property system as a tool for stimulating the generation, protection and commercialisation of intellectual property assets (and thereby encouraging innovation and creativity for economic growth and development and enhancing entrepreneurship and business competitiveness) is also a positive reform that will contribute to the Eco-innovation development in Malawi. The creation of the Malawi Intellectual Property Office (MIPO) will enhance IP administration once it is fully operational. It will be a self-financing parastatal organisation, with income to be generated from registration fees for patents, copyrights and trademarks.

Reasons for success:

- Strong government and political support- Although Malawi is one of the poorest countries in Africa, it has managed to substantially invest on average 1% of its GDP on R&D, one of the highest ratios in Africa, even if R&D spending remains low in real terms.
- Solid anchorage in policies and national plans for the initiatives.
- Increasing support from the private sector and development partners.

3.5.9.2 What doesn't work and why

- *Slow ratification implementation of policies*-Being a member of SADC, Malawi failed to ratify the SADC Protocol on Science, Technology and Innovation (2008) by 2015 which did not have pleasant results if Malawi is compared with Botswana or South Africa in terms of progress in STI. Although the Science and Technology Act of 2003 made provision for the creation of NCST, but only became operational in 2011, with a secretariat resulting from the merger of the Department of Science and Technology and the National Research Council. The Science and Technology Act of 2003 also established a Science and Technology Fund to finance research and studies through government grants and loans. Despite the formation of these institutions, little progress has been made although they provide a strong basis for anchoring Eco-innovation. The revised policy has still not yet been gazetted.

- *Competing priority areas in Malawi and limited financial resources*- In the energy sector, for instance, the Malawi National Energy Policy of 2018 has led to the establishment of the Malawi Rural Electrification Program, and also rehabilitation of old hydroelectric generation plants of Nkula and Kapichira. This has contributed significantly to energy accessibility & efficiency of production and subsequently reduced emissions. However, more emphasis has been placed on the development of the agriculture sector to the detriment of the other sectors, understandably so.

- *Low capacity in the implementation of STI issues and the lack of implementation framework* have hampered innovation development for a long time but there have been encouraging signs of reversing this as many institutions and policies are being developed. The Malawi NIS seems to be elaborate enough but requires strengthening of the capacity of staff and the infrastructure required to optimally function. Poor coordination amongst stakeholders can also be blamed for the poor development of the sub-sector.

- *Insufficient funds to support STI in Malawi*-The major undoing in the development of Eco-innovation in Malawi is the financial capacity of the country that is also facing pressing competing priorities. The Science and Innovation Fund has not been fully rolled out which would boost Eco-innovation in the country. There is very low private sector involvement that

can also be improved to increase investment in research and innovation as well as technology transfer and capacity building.

3.6 Eco-innovation Related Policies and Institutions in Nigeria

3.6.1 Overview

Nigeria has made some progress in socio-economic terms in recent years but its human capital development remains weak due to under-investment. It ranked 152 of 157 countries in the World Bank's 2018 Human Capital Index[18]. The country continues to face massive developmental challenges, including the need to reduce the dependency on oil and diversify the economy, address insufficient infrastructure, build strong and effective institutions, as well as address governance issues and public financial management systems. These pre-existing structural challenges have left the Nigerian economy especially vulnerable to the COVID-19 outbreak and its consequences.

Inequality, in terms of income and opportunities, remains high and has adversely affected poverty reduction. The lack of job opportunities is at the core of the high poverty levels, regional inequality, and social and political unrest. Without the COVID-19 shock (the counterfactual scenario), about 2 million Nigerians were expected to fall into poverty in 2020 as population growth outpaces economic growth. With COVID-19, the recession is likely to push an additional 5 million Nigerians into poverty in 2020, bringing the total newly poor to 7 million this year.

The Nigerian environment is under threat by natural and human-induced activities such as drought, floods and erosion, with the high human population exerting pressure on the existing natural resources and environment. Inappropriate mining practices, oil and gas exploration and indiscriminate waste disposal are some of the main activities causing environmental degradation in the country. In the face of these threats to the environment, the Nigerian government has responded through the formulation of policies, strategic plans, programmes and agencies aimed at protecting the environment and ensuring sustainable development.

The Nigeria Vision 20:2020 is the country's long-term development plan that aims to propel the economy to the top 20 economies globally by the year 2020 and to achieve a high standard of living for the citizens. The Vision focuses on making efficient use of human and natural resources for rapid economic growth and also translate economic growth into equitable social development for all citizens. Concerning energy, the vision focuses on meeting the energy demand for all sectors of the economy with safe, clean and affordable energy in a manner that is technically efficient, economically viable and environmentally sustainable.

The National Economic Empowerment and Development Strategy (NEEDS) of 2004 is a medium-term poverty reduction strategy in Nigeria derived from the country's long-term goal of poverty reduction, wealth creation, job creation and value re-orientation. The NEEDS is, therefore, a reasoned response to the challenges of underdevelopment in Nigeria. The strategy aims to increase both human and natural resource efficiency through privatization, thus shrinking the public domain. The NEEDS recommends an increased share of renewable energy in the national energy mix. This involves a suggestion to create a renewable energy agency and technologies that

[18] https://www.worldbank.org/en/country/nigeria/overview

will be funded by the government. This is an eco-friendly milestone in the energy sector to ensure that renewable energy contributes to rural electrification.

The Economic Recovery and Growth Plan, 2017-2020 was developed in 2017 to restore economic growth while leveraging the ingenuity and resilience of the Nigerian people. This plan supports Eco-innovation through its recognition of the need to support science, technology and innovation and build a knowledge-based economy. The plan is consistent with the SDGs given that it endeavours to address economic, social and environmental issues. This plan aims to achieve sustained and inclusive growth through investing in the people and building a globally competitive economy. To build the economy's competitiveness, the plan recommends a digital-led strategy for growth, through the establishment of an ICT ecosystem in the country.

3.6.2 Enablers and/or constrainers of Eco-innovation in Nigeria

Even though Nigeria has not fully embraced aspects of Eco-innovation as core to its quest for ensuring sustainable development, several factors can be considered as enablers in the right direction. For instance, institutional factors like regulations and standards are important drivers for Eco-innovation. These regulations and standards can either emanate from an external source like the government, where an organization may be required to adhere to a certain limit of carbon emission or pollution in its operations, like the management of solid and hazardous waste regulation, meant to control pollution. In addition, some production companies are required to comply with certain standards especially in food production to meet the market requirements, like the organic standards in the EU market.

At the company level, the need to minimize costs, increase productivity and market demand is a strong driver for the company to operate efficiently, minimizing resource utilization and venturing into new and more productive technologies which are eco-friendly. For instance, the pulp and paper industry of Nigeria has shown a strong relationship between the adoption of green technologies and financial performance and operational efficiency (Adelegan, 2018).

Another important factor driving Eco-innovations in Nigeria is changes in consumer demands and preferences. With the increasing consumer awareness of food safety and health conscience in the countries, the consumption trends are shifting towards a green product. For the companies to keep up with the changing demand, they are forced to adopt cleaner and greener production technologies. The media sector support Eco-innovation by ensuring innovative and effective information dissemination on the various issues therein to government, corporate bodies and individuals; Publishing environmental-related journals and magazines; Spotlights of such processes and products that would change or contribute to resources efficiency and green growth. With respect to civil society organizations, they are more in advocacy, awareness creation and research.

Private sector practitioners support the innovation by operating climate-smart resource centres and are promoting the establishment of climate-smart, community-based agro and allied Resources Development centres across all the 8809 wards in Nigeria. Training/ capacity-building on Green House Gas (GHG) emissions reduction driven by the Federal Ministry of Environment across the sector sectors especially the critical sectors also act as an Eco-innovation driver. Another Eco-innovation driver in Nigeria is support program from government legislation through the (CITES) flora and fauna program - a multilateral treaty to check deforestation and endangered plant and

animal species and the policy of plant three trees after cutting down one-as well as other international conventions such as the UNFCCC.

On the other hand, Nigeria faces several factors that constrain its capacity to adopt Eco-innovation principles and practices. The lack of a concise government agenda and policies that encourage private sector participation and investment in cleaner technology is a major constraint. The state of infrastructure development in most Nigerian cities is a major drawback in terms of adopting eco-friendly practices. For instance, the country's inability to use mass transportation means is a major challenge in reducing carbon emission, since motorcycle transportation is the most common mode of transport in the cities. Additionally, the government's failure to incentivize Eco-innovations within the private sector poses a major drawback hence limiting their participation. For example, a hydrogen-powered bus developed in 2009 costs US$ 1.5 million, making it unaffordable for many.

The government's unwillingness to access funds for greener investments, such as the ***Global Environment Facility (GEF)***, which funds sustainable and energy-efficient transport in Africa is a clear indication of its lack of support in Eco-innovation. Also, the successive governments have done very little if any in ensuring sustainable waste disposal especially in the cities and other major towns. This is evident from the indiscriminate waste disposal by the residents as well as the government agencies. Only Lagos State is currently implementing a waste disposal strategy. Additionally, the poverty level in Nigeria poses a financial constraint in adopting new Eco-innovations.

3.6.3 Eco-innovation related Policies and Frameworks in the Energy sector- Nigeria

Nigeria is a resource-abundant country with the energy sector contributing significantly to the country's GDP. This sector is dominated by fossil fuels like oil and gas. However, the country's energy production, supply and demand have not been parallel. The majority of rural residents are not connected to the national grid (UNDP-WHO, 2009). In a bid by the government to boost the energy supply in the country, it has taken some steps to increase thermal energy production. However, increasing the country's energy availability and connectivity requires diversification of energy sources and production, including renewable energy sources. Various policies are in place to guide and support this sector, some of which are eco-friendly.

The National Energy Policy of 2003 offers a roadmap to a better energy sector in the future. According to this policy, the level of energy utilization in an economy, coupled with the level of efficiency in the conversion of energy sources to useful energy is a strong indicator of economic development. This policy recognizes the multi-dimensional nature of the energy sector, which comprises crude oil, tar sand, natural gas, hydroelectricity, biomass, solar energy, and wind energy among others. The objectives of this policy include ensuring the development and diversification of the country's energy resources, to achieve a secure and efficient energy delivery system with an optimal energy resource mix. This policy is eco-friendly in the sense that it guarantees an adequate, reliable, cost-effective and sustainable energy supply in an environmentally friendly manner.

The Renewable Energy Master Plan of 2005 sets out the roadmap for increasing the role of renewable energy in achieving Nigeria's sustainable development goals. The country envisions a

peaceful and prosperous nation driven increasingly by renewable energy. The overall objective of this plan is to articulate a national vision, targets and a roadmap for addressing key development challenges facing the country through increased development and exploitation of renewable energy. This was achieved through improving learning, capacity building, research and development on various renewable energy technologies. It also aims to reduce environmental degradation and health risks, particularly to the vulnerable population like women and children, hence a clear indication of its support for Eco-innovation.

The Nigerian Bio-fuel Policy and Incentives of 2007 recognizes the potential of biofuels to make a significant impact on the petroleum products quality enhancement, given the current limitations of fossil fuels to meet the escalating demands of environmentally friendly energy (See Box 9 for details). The goal of this strategy is to establish a thriving fuel ethanol industry by utilizing agricultural products as a means of improving the quality of automotive fossil-based fuels in Nigeria. This strategy is environmentally benign since it focuses on reducing tailpipe emission and Ozone pollution, reduction in particulate emissions and replacement of toxic octane enhancers in gasoline.

The National Renewable Energy and Energy Efficiency Policy of 2015 recognizes the multi-dimensional nature of energy sources in Nigeria and therefore addresses the diverse challenges of renewable energy supply, utilization, legislation, regulation, efficiency and conservation. With the economic constraints facing Nigeria, this policy helps to realize the potential of renewable energy in contributing to the economic growth of the country. This policy is eco-friendly since its implementation will increase the efficiency, security and reliability of energy supply, thus improving the people's living standards and also reduce the negative environmental impacts such as air, water and soil pollution.

Box 9: Nigerian Bio-fuel Policy and Incentives of 2007

Nigerian Bio-fuel Policy and Incentives of 2007 established a fuel ethanol industry by utilizing agricultural products as a means of improving the quality of automotive fossil-based fuels. A research agency to be known as the Bio-fuels Research Agency was established to act as the central coordination body for bio-fuel research in the country. The Agency coordinates bio-fuel crop production optimization programme and collaborate with the research and development efforts of International Institute of Tropical Agriculture (IITA), National Cereal Research Institute (NCRI), National Root Crops Research Institute (NRCRI), Nigerian Institute For Oil Palm Research Council (NIFOR), Forestry Research Institute Nigeria (FRIN), Nigerian Stored Products Research Institute (NSPRI), Institute for Agricultural Research and Extension Services (IARES), Agricultural Research Council of Nigeria (ARCN), National Biotechnology Development Agency (NABDA), SHEDA Science and Technology Complex (SHESTCO) Federal Soil Conservation School (FSCS), National Centre for Agricultural Mechanisation (NCAM), National Agricultural Seeds Council (NASC), Nigerian Automotive Council, Raw Materials Research and Development Council (RMRDC) and Federal Institute of Industrial Research Oshodi (FIIRO) and other relevant agencies in environmental sectors.

https://inis.iaea.org/search/search.aspx?orig_q=RN:46063467

Table 27 below provides the key actors in the Energy sector in Nigeria and their role in promoting Eco-innovation in the sector.

Table 27: Eco-innovation relevant Institutions and actors in the Energy sector- Nigeria

Name of institution/actor	The role played in support of Eco-innovation
The Federal Ministry of Power	It is the overall government organ mandated to make all electricity-related policies and ensure the coordination of comprehensive and efficient energy policies
Nigerian Energy Commission	Mandated to guarantee an adequate, sustainable and optimal supply of energy in a cost-effective and environmentally friendly manner
Nigeria Electricity Regulatory Commission	Mandated to ensure adherence and compliance with energy regulations and standards.
Standard Organization of Nigeria	Mandated to ensure adherence and compliance to the set electricity regulations, licensing, standardization of equipment and environmental impacts.
The Renewable Energy Division	It is mandated to create the biofuels industry in Nigeria.
The Bio-fuels Energy Commission	Responsible for implementing all the bio-fuels related strategies in the country.
Centres for Energy Research	Mandated to conduct research activities for alternative and more efficient sources of energy for both domestic and industrial use, for instance, the research on using solar energy for domestic cooking.

3.6.4 Eco-innovation related Policies and Frameworks in the Environment sector-Nigeria

The Nigerian environment has been under immense pressure owing to various factors like high human population, deforestation, poverty, pollution and urbanization among others (Leke and Leke, 2019). In response to these challenges, Nigerian governments have formulated policies, agencies and programmes aimed to protect the environment and ensure sustainable development.

The National Environment Policy of 1989, revised in 1999 provides a good policy ground on which various environmental and land degradation challenges facing the country can be addressed. The policy was revised in 1999 to accommodate new and emerging environmental concerns. The goal of the revised policy was to achieve sustainable development in Nigeria, with a particular focus of securing the quality of environment adequate for good health and well-being, promote sustainable use of natural resources, restore and maintain the ecosystems and ecological processes, and preserve the biodiversity.

The National Policy on Drought and Desertification of 2018 recognizes the impacts of climate change on the environment such as intensification of desertification and drought in the country. This policy emphasizes the need for the relevant government bodies to collect, analyse and use climate change information and data to combat desertification and drought. To achieve its objective, the policy directs the development of appropriate awareness creation programmes through formal and informal education to enhance knowledge on environment and climate-related issues. Besides, it encourages eco-friendly land-use practices that promote carbon dioxide sequestration such as afforestation, re-afforestation and agroforestry.

The Nigerian National Forestry Policy of 2006 recognizes forestry resources as a profitable venture to the economy and therefore encourages and supports the establishment of both exotic and indigenous trees. The policy's strategic objectives are in tandem with the country's sustainable

development goal of poverty reduction. This policy is eco-friendly in the sense that it recognizes and supports the contribution of forestry resources to attaining food and nutrition security, biodiversity conservation and environmental protection like the role of trees in carbon dioxide sequestration, protection of environment and conservation of watershed areas thus mitigating against global warming.

The National Biodiversity and Action Plan of 2016-2020 appreciates the country's rich biodiversity resource base and its role in the economy, ecology and the people's social lives. It also recognizes the existing threats to its perpetuity such as pollution, over-exploitation, invasion of alien species and climate change. This plan envisions a healthy living environment where people live in harmony with nature and sustain the full benefits of biodiversity. It also aims to incorporate biodiversity into the national agenda geared towards poverty reduction, ecological sustainability and social equity, thus promoting green growth.

The Nigeria Climate Change Policy and Response Strategy of 2012 aims to promote low-carbon, high-growth economic development and build a climate-resilient society. This is achieved through the implementation of appropriate mitigation measures that promote low carbon, sustainable and high economic growth, enhancing the national capacity to adapt to climate change, increasing climate change-related research and development activities to enable the country to better participate in climate-related scientific and technological cooperation, as well as increasing the public awareness and private sector participation in addressing the climate change-related challenges among others.

The National Adaptation Strategy and Plan on Climate Change for Nigeria of 2011 diagnoses the cross-sectoral impacts of climate change in the country. This strategy envisions a country in which climate change adaptation is an integral part of its sustainable development, by reducing the people's vulnerability and resilience capacities to climate change. This strategy takes inclusive measures of adaptation such as improving climate change awareness and preparedness, mobilizing communities for climate change adaptation actions, reducing climate change impacts on key sectors and the vulnerable communities, and integrating climate change adaptation into the national, sectoral, state and local government planning, among others, thus a strong supporter of green growth.

Table 28 below provides the key actors in the Environment sector in Nigeria and their role in promoting Eco-innovation in the sector.

Table 28: Table: Eco-innovation relevant Institutions and actors in the Environment sector-Nigeria

Name of institution/actor	The role played in support of Eco-innovation
The Federal Ministry of Environment	Mandated to coordinate, promote and facilitate environmental and biodiversity conservation measurers
The Federal Environment Protection Agency (FEPA)	Is charged with the responsibility of environmental protection, biodiversity and natural resource conservation, including policy matters related to desertification
State Environmental Protection Agencies (SEPA)	Works in collaboration with other relevant ministries such as the ministry of agriculture to protect the environment and its

	biodiversity. It is also mandated to create awareness on environmental issues through the Public awareness Master Plans.
National Biodiversity Monitoring and Evaluation Coordination Unit	Leads and coordinates the implementation of all biodiversity conservation-related policies and frameworks in the country.
National Biodiversity working Group	Ensure periodic and regular monitoring of biodiversity-related project being implemented in the country.
Organized Private sector	Work with other stakeholders like CSOs to engender climate change adaptation at the grass-root level. Also, responsible to buy in the opportunities presented by climate change adaptation and invent new technologies.
Civil Society Organizations (CSOs)	Create public awareness on the impact of climate change and mitigation strategies. Also, research on environment and climate change-related issues.

3.6.5 Eco-innovation related Policies and Frameworks in the Agriculture and Natural resources sector-Nigeria

The Nigerian agriculture sector plays a key role in ensuring food security to the population as well as earning the country some foreign exchange. Over the years, this sector has experienced some shortfalls due to the effects of climate change and environmental degradation, emanating from human activities. To revive the significance of this sector, the government has put in place various policy and strategic measures.

The Agriculture Promotion Policy (2016-2020) aims to increase agricultural productivity in Nigeria. Nigeria still imports a significant amount of food. It is also not earning significant foreign exchange from agriculture, meaning, losses on both ends. Therefore, it became paramount to "refresh our strategy" to tackle these 2 issues head-on. The purpose therefore of this policy document is to provide a disciplined approach to building an Agribusiness ecosystem that will solve these two (2) gaps. This policy was originally the Agriculture Promotion Policy of 2006 that aimed to revitalize the agriculture sector through prioritizing food security, import substitution, job creation and economic diversification. Focusing on agricultural growth as a key component of sustainable development, this policy aims to ensure sustainability in the use of natural resources, such as land, soil, water and ecosystems, without compromising future generations while increasing food production, marketing and other human activities in the agriculture sector.

The Global Food Security Strategy- Nigerian Country Plan of 2018 emphasizes the importance of the agriculture sector in the economy. However, it recognizes the challenges facing the sector and its sustainability, such as limited access to quality agricultural inputs, poor post-harvest technologies, ineffective and inefficient pest and disease and pest control measures, and the adverse impacts of climate change among others. This strategy aims to address the challenges facing the optimal performance of the agricultural, health and nutrition sectors in the country. This strategy is eco-friendly since it recognizes the impacts of climate change on economic development, food and nutrition security of the people, especially in Northern Nigeria. It also aims at increasing the communities' and systems' resilience to climate change and promote inclusive and sustainable development in the country.

In Table 29 below, the key actors in the Agriculture and Natural Resources sector in Nigeria and their role in promoting Eco-innovation in the sector have been highlighted.

Table 29: Eco-innovation relevant Institutions and actors in the Agriculture and Natural resources sector-Nigeria

Name of institutions/actors	The role played in support of Eco-innovation
The Federal Ministry of Agriculture and Natural resources	Responsible for the implementation of agriculture-related projects and programmes that aim to protect and conserve the environment such as tree planting and afforestation programmes. It also ensures the implementation of new technologies in the agriculture sector.
The Federal Department of Planning, Research and Statistics	Mandated to research on new technologies and innovations that are efficient and productive to the producers.
Federal Department of Rural Development	Is responsible for formulating policies and strategies for rural development and for fostering integrated and sustainable rural development through ensuring food security and poverty eradication in a sustainable manner
The Federal Department of Land Resources	Is responsible for land management, land use, soil fertility, soil conservation including agroforestry, soil testing, and land survey and evaluation.
The Federal Department of Fertilizer	Conducts tests and trials on new fertilizer technologies and products to generate information for fertilizer recommendations and development. Also promotes the use of organic fertilizers as a way of protecting and conserving the environment
The International Institute of Tropical Agriculture	Working with various partners across sub-Saharan Africa generates agricultural innovations to meet Africa's most pressing agricultural challenges. Also seeks to improve livelihoods, enhance food and nutrition security, increase employment, and preserve natural resource integrity.
The Agricultural Development Programmes (ADP)	Mandated to promote agricultural production and reduce poverty through the provision of improved farm inputs like seeds, fertilizers and pesticides in an environmentally friendly way.
The Fadama programme	Promotes food security and reducing poverty through sustainable use of the existing resources and the use of science and technology for production.

3.6.6 Eco-innovation related Policies and Frameworks in the Trade and Industry sector-Nigeria

Over the years, the Nigerian industry and manufacturing sector has been growing with the key pillars being the oil and gas sectors. Although the country's manufacturing sector is quite broad, not all sub-sectors have reached a significant level of contributing to the country's economic

growth. To tap on the potentials of this sector, various policies and strategic plans have been formulated and implemented to guide and support its growth.

The Nigerian Trade Policy of 2002 appreciates the need to diversify, drive and promote increased value addition in various sectors of the Nigerian economy especially where the country has a comparative advantage. This policy was designed to integrate the country into the global trading system with a view of maximizing the globalization benefits. The policy aims to create jobs, engender economic growth and inclusive development while safeguarding the Nigerian economy from unfair trading practices, protecting the domestic consumers, and the environment from unsustainable practices, thus expressing its support for green growth in the country.

In Table 30 below, the key actors in the Trade and Industry sector in Nigeria and their role in promoting Eco-innovation in the sector have been highlighted.

Table 30: Eco-innovation relevant Institutions and actors in the Trade and Industry sector- Nigeria

Name of institution/actor	The role played in support of Eco-innovation
The Federal Ministry of Commerce and Industry	Responsible for formulating, coordinating and implementing the country's Trade and Industry policies in an environmentally friendly manner.
Standards Organization of Nigeria	Responsible for standardizing the quality of all products in the country
Enlarged National Focal Point	Provides technical backstopping for informed and environmentally viable policy decisions

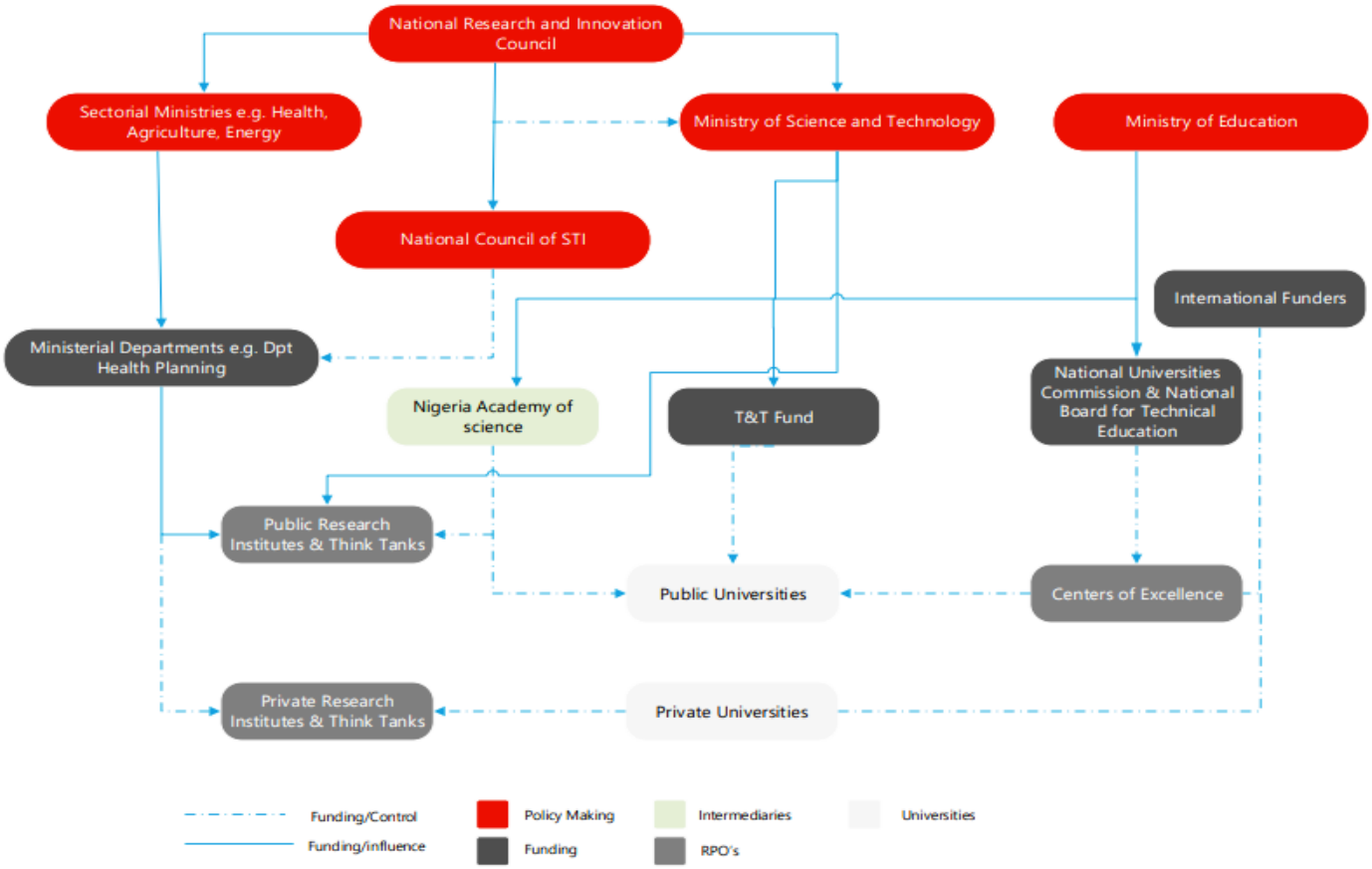
3.6.7 Eco-innovation related Policies and Frameworks in the Science, Technology and Innovation (STI) sector- Nigeria

Rapid economic changes and globalization create new opportunities and challenges. The Nigerian successive administration recognizes the role of STI in spurring economic and social development in the country. These include breakthroughs in biotechnology, space research, energy development and the role of ICT, among others. Although the country has been lagging in terms of STI policies and regulations, there is a renewed commitment to unleash the full potential of the sector and its contribution as a fulcrum to cross-sectoral economic development.

Nigeria's first National Science and Technology Policy was published in 1986 and focused on improving the lives of Nigerian citizens. The policy was first revised in 1997 to improve coordination and management of the science and technology (S&T) system, and in 2003 to develop an institutional framework for S&T. In 2011 the government released a ***National Science, Technology and Innovation Policy 2011*** which sets out ambitious strategies for STI promotion, capacity building, sectoral R&D (for agriculture, water, biotechnology, health, energy, environment, ICT, raw materials and mineral resources, ICT, industry, defence, transport, tourism, housing and forests), intellectual property, technology transfer, information management systems and female participation in research. The policy also recommended establishing a ***National Research and Innovation Fund (NRIF)*** with a minimum of 1% of GDP strategically sourced

from public, private, international sources. The policy states that "the lack of long-term commitment to STI has been a major impediment to economic development" and purported to accord STI a central role in national economic planning through the "establishment of an effective institutional and legal framework" comprising the ***National Research and Innovation Council (NRIC),*** the State Science, Technology and Innovation Council (SSTIC) and the National Council on Science, Technology and Innovation (NCSTI).

In 2013, the government produced a draft ***Framework for the Nigeria National System of Innovation (NSI)*** that articulated the relationship between the Federal, Sectoral, Regional, State and Local Innovation Councils. Finally, in 2017 the Federal Government published the ***National Science, Technology Innovation Roadmap (NSTIR) 2030***, a high-level document that lays out the long-term framework for science and technology. The document sets specific goals for many knowledge sectors and focuses on linking research in all areas to national development and supporting industrial innovation. It aims to facilitate the creation and acquisition of knowledge for production, adaptation, replication, and utilization of technologies, support the establishment and strengthening of STI organizations, institutions, structures and processes, coordinate and manage STI activities and promote the creation of innovative enterprises.



Source: DFID, (2019c)

Figure 6: Stakeholder relationships in Nigeria's research system

In Table 31 below, the key actors in the Science, Technology and Innovation sector in Nigeria and their role in promoting Eco-innovation in the sector have been highlighted.

Table 31: Eco-innovation relevant Institutions and actors in the Science, Technology and Innovation (STI) sector-Nigeria

Name of institution/actor	The role played in support of Eco-innovation
Federal Ministry of Science and Technology (FMST)	Mandated to formulate, coordinate and implement STI policies in the country
National Council on Science, Technology and Innovation (NCSTI)	NCSTI sets broad directions to coordinate STI activities in line with national priorities, monitors the activity of public STI agencies and is responsible for the dissemination of outputs from scientific research.
State Science, Technology and Innovation Council (SSTIC)	SSTIC provides leadership and direction for STI activity at a state level, promote science education and disseminate STI information, align policies and programmes with those of the NRIC, promote and implement decisions and programmes of NCSTI.
National Centre for Technology Management	Conducts research, training and capacity building activities in collaboration with other institutions to ensure effective and sustainable STI development in the country.
National Research and Innovation Council	Mandated to set national priorities in research and development. Also promotes and disseminates technologies and innovation information.
Tertiary Education Trust Fund (TETFund)	TETFund was established to promote higher education, provide grants in three areas: humanities and social sciences, STI and cross-cutting research.
Raw Materials and Research Development Council (RMRDC)	It is an Agency under the Federal Government of Nigeria whose mandate is to promote the development and utilization of industrial raw materials in the country. Also aims to reduce the dependency on imported industrial raw materials and increasing production thus supporting sustainable industrial growth and development. It also provides relevant information to the government for the formulation of appropriate policies on exploitation, investment and utilization of raw materials.

3.6.8 Eco-innovation related Policies and Frameworks in the Transport sector- Nigeria

The Nigerian transport sector can be regarded as the engine of growth and development owing to its crucial role in linking all other segments of the economy into one mainstream. It is also a significant contributor to the economy through job creation especially to the youth, movement of goods, people and services within and across sectors, thus facilitating the productivity of other sectors (Ugboaja, 2013). At the same time, the transport sector contributes to major environmental pressures air pollution, natural resource depletion and waste accumulation. As a result, there is a dire need for the government and other relevant bodies to ensure the economic, social and environmental sustainability of the sector.

The Nigerian Draft National Transport Policy of 2010 aims to develop an adequate, safe, environmentally sound, efficient and affordable integrated transport system for a progressive and competitive economy. According to this policy, all transport-related investments should be subject to thorough analysis to ensure that the benefits and costs are practical and sustainable. This policy recognizes the role of PPPs in providing investments to address the challenge of infrastructure deficit and sustainably improve service delivery. This policy is eco-friendly since it focuses on protecting and enhancing the natural environment, by minimizing greenhouse gas emissions and other pollutants.

The National Policy on Public-Private Partnerships of 2018 identifies the huge deficits in the national infrastructure as one of the key challenges constraining the economic growth of the country, especially in the energy and transportation sectors. The goals of this policy are social, economic and environmental. On the social dimension, it focuses on enhancing the health, safety and wellbeing of the public among others. On the economic front, its focus is on improving the availability, quality and efficiency of power, water and transport among other public services to increase productivity, competitiveness and access to markets, while encouraging efficiency, innovation and flexibility. On the environmental grounds, it focuses on reducing greenhouse gas emissions and pollution as a way of protecting the environment, thus expressing its support for Eco-innovation.

The National Integrated Infrastructure Master Plan (2015-2043) is Nigeria's blueprint for cross-sectoral infrastructure development that guarantees sustainable economic growth and development. This master plan is cognizant of the economic impacts of climate change in the country, with specific emphasis on the food, energy and water security in the country. It states that climate change has a great impact on infrastructure development in the country since it is more costly to make it climate-resilient. As a precautionary measure, this plan recommends a cost-benefit analysis of building climate-resilient infrastructure, bearing in mind that the initial or upfront investment may be cheaper than future maintenance, thus its support for Eco-innovation.

The key actors in the Transport sector in Nigeria and their role in promoting Eco-innovation in the sector have been highlighted below (Table 32).

Table 32: Eco-innovation relevant Institutions and actors in the Transport sector- Nigeria

Name of Institution/actor	The role played in support of Eco-innovation
Federal Ministry of Transport	Formulate and implement policies to ensure the sector meets its economic and development targets. Also ensures efficient utilization of resources with minimal negative environmental impacts, like minimizing air pollution.
Infrastructure Concession Regulatory Commission	Mandated to develop the guidelines, policies and procurement processes, as well as ensuring orderly and harmonized infrastructure development that protects and conserves the environment.
National Planning Commission	Mandated for all infrastructure development strategies as provided by the Federal Government. Also, commissions research activities for assessing the economic and environmental impacts of the programmes and projects.

3.6.9 What works, what doesn't work and why in Nigeria

Nigeria recognizes that sustainable development requires that national institutions work in a coordinated manner rather than in organizational isolation. It requires not only cross-sectoral but also multi-level coordination with the active involvement of all stakeholders. The country has in place a number of institutions and mechanisms both at national and state levels, each having different roles and responsibilities. Nigeria is also working towards bringing about more coordinated and integrated policy development and stakeholder engagement in decision making and action plans for national sustainable development. Below are some of the projects and initiatives that have been implemented with some success and others have not been so successful for some reasons.

3.6.9.1 What works and why

a) Niger Delta Biodiversity Project

Supporting policies and strategies: The National Environment Policy of 1989 (revised in 1999), the National Biodiversity and Action Plan of 2016-2020, the Nigeria Climate Change Policy and Response Strategy of 2012, the National Adaptation Strategy and Plan on Climate Change for Nigeria of 2011.

Description and impact: The Niger Delta wetlands have been referred to as the largest biodiversity hotspots in Africa that inhabit several species that are endemic in the region. It was also reported that biodiversity that is internationally and locally endangered is found in the Niger Delta region. Typically, biodiversity involves all species of life forms including plants, animals and microbes that play an essential role in the ecosystem. This project targeted Nigeria's Oil and Gas sector (O&G), which is the backbone of Nigeria's economy, and touch upon the sectors interface with biodiversity. This is especially relevant, as the bulk of Nigeria's O&G resources are found in the biodiversity-rich Niger Delta Region. The programme was designed to catalyze the changing tide through a strategic engagement mechanism that works with O&G companies to adopt a new common Biodiversity Action Plan (BAP) framework and commit to biodiversity action planning and cartelize new partnership platform called the Niger Delta Trust that brings together local communities, the O&G sector, government for improved biodiversity mainstreaming. The project has contributed to the conservation and sustainable use of globally significant biological diversity in the Niger Delta and its main objective is to mainstream biodiversity management priorities into the Niger Delta O&G sector development policies and operations. The project has significantly improved biodiversity management in these areas indirectly and directly.

Reasons for success:

- The project's intervention focused on three key Components: the governance framework for law, policy and institutional capacity to enable the mainstreaming of biodiversity management into the O&G sector.
- The government, the O&G industry and local communities built and piloted new biodiversity action planning tools for the proactive biodiversity management
- Stakeholders support long-term biodiversity management in the Niger Delta by capitalizing and accessing the Niger Delta Biodiversity Trust as a collaborative engagement mechanism for local communities, O&G companies and the Government.

b) Global Environment Facility–Small Grants Programme (GEF-SGP)

Supporting policies and Strategies: The National Environment Policy of 1989 (revised in 1999), the National Biodiversity and Action Plan of 2016-2020, the Nigeria Climate Change Policy and Response Strategy of 2012, the National Adaptation Strategy and Plan on Climate Change for Nigeria of 2011.

Description and Impact: Launched in 2009, GEF-SGP Nigeria supports non-governmental and community-based organizations in Nigeria to protect the environment while generating sustainable livelihoods for the poor and marginalized in developing countries. Funded by the Global Environment Facility (GEF), GEF-SGP is implemented by UNDP on behalf of the GEF partnership and is executed by the United Nations Office for Project Services (UNOPS). The United Nations Development Programme (UNDP) Country Office has described GEF-SGP as the bottom-up complement of its top-down policies in the country. Since its inception in March 2009, GEF-SGP Nigeria has established a strong foundation of the country programme through the support of the National Steering Committee (NSC). GEF-SGP has helped to raise awareness of environmental issues, built capacity for and project conceptualization, proposal and report writing, and engagement of communities in environmental initiatives. GEF-SGP has also contributed to all relevant Multilateral Environmental Agreements such as CBD, UNFCC, CITES, UNCCD etc. The achievements are numerous including over 500 indigenous plants, species conserved, 50% of beneficiary communities have either never experienced or benefitted from any development support or participated in such a way as allowed by SGP. Supported establishment of Community Forest Management Committees and capacity building for forest protection and to enhance indigenous knowledge of biodiversity and revive interest in traditional medicinal values of plants species. SGP Nigeria has supported over 30 climate change mitigation projects addressing; Awareness creation and teaching simple technique of Rainwater harvesting to reduce the stress of water and the impact of drought; supported Pitcher Irrigation technology for farming; tree planting to regenerate forests which act as a sink for CO_2 and fuel-efficient stoves to reduce consumption of fuelwood.

All SGP Projects have supported alternative livelihood activities that have helped to reduce pressure on the environment and also enhance the quality of lives of the target communities. Some of the projects have established by-laws that help to protect the environment and enforcement of environmental conservation principles through traditional arrangements. Lagos State has adopted the results of the Saw Dust Project leading to the establishment of a comprehensive environmental management system for sawmills in Lagos. Following project results, some grantees have carried out advocacy activities writing letters, press releases and direct meeting with politicians to seek further support for environmental management.

Reasons for success:

- GEF-SGP is rooted in the belief that global environmental problems can best be addressed if local people are involved and there are direct community benefits and ownership.
- Strong community participation- members of local communities can undertake activities that will make a significant difference in their lives and environments, with global benefits.
- Bottom-up, expert-reliant development interventions and in a decentralized and country-driven manner, through National Coordinators and National Steering Committees and a Central Programme Management Team based in New York.

- Focused on the development of community-level strategies and implementation of technologies that could reduce threats to the global environment if they are replicated over time.

c) Application of Sustainability Science in all sectors

Supporting policies, strategies and plans: Environmental Impact Assessment Act of 2004, Harmful Waste Act of 2004, National Park Service Act of 2004, Control of International Trade and Traffic Act of 2004, National Oil Spill, Detection and Response Agency (NOSDRA) Act, National Environmental Standards and Regulations Enforcement Agency (NESREA) Act of 2007.

Description and impact: Nigeria recognizes that science and technology are critical in the service of a transition towards sustainability and in understanding the complex interactions of global processes with the ecological and social characteristics of particular places and sectors, as well as the society's capacity to guide the relevant interactions towards a more sustainable development pathway. The government will support the sustainability science approach to its struggle to meet the needs of a growing population that is projected to more than double and to reach about 244 million in 2050. This will enable the country to advance its ability to analyze and predict the behaviour of the complex and multi-dimensional nature-society interactions that are expected to result from the pressures our development efforts are putting on the Earth's essential life-support system. Scientists and practitioners will be supported to work together to produce genuine and coherent problem-solving knowledge that combines scientific excellence with social relevance in the national stride towards sustainable development. Thus, sustainability science is being pursued to develop scientific breakthroughs in the economic, social and environmental pillars of sustainable development for Nigeria's development.

Reasons for success:

- Establishment of a robust NIS that has strong linkages between actors in STI
- Establishment of institutions mandated to perform various critical services that enhance coordination

d) A functioning institutional setup and effective implementation of key policies, guidelines and regulations

Supporting policies and Strategies: Vision 20:2020, the National Economic Empowerment and Development Strategy (NEEDS) of 2004, the Economic Recovery and Growth Plan, 2017-2020, the National Environment Policy of 1989, revised in 1999, the National Policy on Drought and Desertification of 2018, the Nigerian National Forestry Policy of 2006, the National Biodiversity and Action Plan of 2016-2020, National Science, Technology and Innovation Policy of 2011 and the National Policy on Public-Private Partnerships of 2018.

Description and impact: The Federal Government's key priority policies, programmes and projects that will translate the Vision and the National Implementation Plan into meaningful development in the country are captured in the government's Transformation Agenda. The Agenda is based on a set of priority policies and programmes, which when implemented will ensure continuity, consistency and commitment of national development efforts that will transform the Nigerian Economy to meet the needs of the Nigerian people. To translate the projects emanating from the Transformation Agenda into reality, a number of policy and regulatory enablers have

been put in place, including laws, regulations, policies, public infrastructure, public services and international trade agreements that will facilitate the activities of economic agents, making it possible for them to be competitive, function optimally and operate profitably while ensuring sustainable development.

Many ministries, departments and agencies (MDAs) play a significant role in the designing of strategies and their effective implementation to achieve desired goals. There are also some specific commissions or councils or multi-sectoral authorities, and research institutes and universities, as well as many initiatives towards promoting inclusive socio-economic growth and environmental sustainability. Key among the Ministries for the economic pillar of the country's sustainable development are those of Agriculture, Finance, Industry, Trade and Investment, while those advancing the social pillar are those of Education, Health, Women Affairs, Youth and Sports Development. Leading the overall environmental issues is the Ministry of Environment. Others in the drive towards environmental sustainability include the Ministries of Land, Housing and Urban Development, Science and Technology and Water Resources.

The National Planning Commission plays a key role in planning by assessing, prioritizing and allocating resources through Mid-Term Strategies (MTSS). The Federal Government recognized the need for inter-ministerial and multi-level governance coordination of programmes. Inter-ministerial and expert committees have also been constituted to assist the government pertaining to issues of topical interest. National Councils in various sectors are also in place to act as apex advisory bodies. The National Council on the Environment, in particular, has been active in coordinating matters related to sustainable development to ensure that ministries and departments across the sectors work individually as well as in tandem with each other to attain socio-economic development and environmental sustainability. It is being strengthened for a more coordinated approach to sustainable development in Nigeria, and to ensure that local governments and other local institutions, as well as CSOs, are more actively involved in the preparation of plans for sustainable development and their effective implementation in several aspects of governance.

Several administrations since independence have signified interest and increasing appreciation of the role of STI in national socio-economic development. The actualization of this fact is the rationale why the Federal Government of Nigeria re-established the Federal Ministry of Science and Technology (FMST) as an individual entity in the year 1985. Since then, Nigeria has made use of plenty of efforts on STI policy development. Having a dedicated STI ministry provides a solid foundation for the development of the Eco-innovation subsector. This also increases the chances for increased funding for its activities as opposed to having it as a department in some other ministry. The policy also recommended establishing a National Research and Innovation Fund (NRIF) with a minimum of 1% of GDP strategically sourced from public, private, international sources. The acknowledgement that the lack of long-term commitment to STI has been a major impediment to economic development and recommendation to accord STI a central role in national economic planning through the "*establishment of an effective institutional and legal framework*" comprising the National Research and Innovation Council (NRIC), the State Science, Technology and Innovation Council (SSTIC) and the National Council on Science, Technology and Innovation (NCSTI) is a major boost and can significantly enhance Eco-innovation if fully implemented. The National Environmental Standards and Regulations Enforcement Agency (NESREA), a parastatal of the Federal Ministry of Environment established

by the NESREA Act 2007. One major regulation is a mandatory requirement for EIA for projects and the result publicly displayed as a requirement for approval before implementation. NESSREA has had a number of achievements including a number of seizures of species and animal parts that were being transhipped through its ports and prosecuted some prominent cases, including non-nationals, some of whom were sentenced to serve prison terms. It has also been responsible for the discovery of obsolete and used electrical and electronic equipment that was about to be dumped within Nigeria, turning them back to their ports of origin. Nigeria is currently witnessing a boom in the use of technological equipment leading to the massive production of electronic waste in urban centres. As a result, NESREA began to work in this sector to establish the application of the extended producer responsibility principle in waste management (other sectors of the economy such as the food and beverage industry are also involved). To achieve this, it set up a nationwide programme and published guidelines for the relevant industry players.

Reasons for success:

- Effective inter-ministerial and multi-level governance coordination.
- Participatory planning by assessing, prioritizing and allocating resources through Mid-Term Strategies.
- Setting up of Inter-ministerial and expert committees to assist the government about issues of topical interest.
- Ratification and compliance with many international treaties and conventions.

3.6.9.2 What doesn't work and why

There have been many projects and initiatives aimed at mainstreaming environmental sustainability into the various developmental programmes in the various sectors. These have resulted in mainly positive strides that have enhanced Eco-innovation. However, not all the initiatives achieved all they had set to achieve. Some areas did not work well or completely failed. Since there are so many initiatives, we will only highlight some of the reasons for the failure or sub-optimum performance.

- *The technological foundation for manufacturing is lacking* in most sectors despite some of the programmes having strong capacity building components. The skilled human resources needed to support competitiveness in today's dynamic and globalized world is inadequate. Systemic challenges of infrastructure, mainly connected to power and transport, have led to a rapid increase in costs and non-competitive operations. For this reason, most of the sectors are not able to attract the requisite investment for economic growth while ensuring environmental sustainability. The major challenge for the country is to adopt and use environmentally sound technologies (ESTs), whether exogenously or endogenously developed because they will contribute significantly to productivity and the sustainability of resources through renewable-energy generation, pollution control and waste reduction.

- *The lack of research infrastructure, human resources capacity and financial resources* are increasingly derailing the government targets in the sector. Higher education and research institutions in Nigeria are troubled with not enough science and technology facilities and materials for practical skills growth. Most laboratories lack the basic equipment for meticulous scientific research. The current infrastructural foundation in Nigeria is grossly insufficient in terms of capacity and quality and is not able to cater for the expected industrial development.

Despite government investments, Nigeria still has a huge infrastructure shortfall, specifically with respect to electricity production. Research activities require sufficient energy and other resources and the limited availability of these would not have the expected results as far as Eco-innovation and other innovations are concerned.

- *The devastating effects of climate change* are already manifesting in increasing extreme climatic events particularly storms, flooding and rising temperatures as well as altered climatic and weather regimes. These are creating many other effects such as declining productivity of rain-fed agriculture and relocation of populations with all its consequences. In the long run all the sectors of the economy could be severely impacted with huge losses including life. This would slow down the pace of development in the country as many economic activities are climate sensitive. There could be shift in the boundaries of ecological belts. The challenge is the promotion of climate compatible development for disaster risk reduction and sustainable development. Severe land degradation continues to ravage the country, resulting in drastic reduction in the productivity of land resources. Reducing the rate and severity of desertification and reversing land degradation is a key challenge for environmental sustainability and sustainable development of the country. Despite their devastating impacts on many sectors of the economy and the livelihoods of the people, the management of environmental hazards and disasters remains a major challenge, due generally to inadequate capacity for their effective prediction, mitigation and management.

- *Poor waste management that is prevalent in Nigeria* is inimical to the sustenance of the environment as well as the overall economic development of the country. Controlling indiscriminate dumping of household and industrial wastes on land, water and air remains a major environmental challenge. Pollution continues to be a major environmental challenge in the country, with a significant impact on the well-being of the country's environment and the people. Nigeria ranks among the most urbanized countries in the world. The pace of urbanization increase has been such that maintenance of modest environmental standards had inevitably lagged behind. The functionality of most urban areas is thus reduced in addition to exerting adverse impacts on households, macro-economic performance and social well-being. This situation poses a major challenge to economic growth and sustainable development.

- *Weak and fragmented environmental governance* remains a major bane of environmental sustainability in the country. Many of the institutions dealing with environmental issues have the weak capacity and adopt sectoral, rather than integrated, approaches. They are generally under-funded and ineffective in their core functions to have a meaningful impact on environmental sustainability. Weak enforcement of laws and weak implementation of policies remains a major issue of concern in Nigeria's environment sector. Nigeria's coastal region suffers degradation from diverse human activities, particularly oil exploration and exploitation, agricultural and industrial development. Attempts to address critical environmental problems have been mainly piecemeal. The main challenge for the sustainable management of the coastal and marine environment is to put in place an integrated approach that will address the issues. National efforts to address environmental issues have not been broad-based. But, broad public participation in decision-making processes is one of the fundamental preconditions for sustainable development. This will enable many Nigerians to be aware of their role in environmental management and also enhance their access to timely and accurate information

on the environment. Sound environmental management has to be based on openness and inclusiveness at all levels. Therefore, environmental education and public awareness must be promoted to ensure broad-based environmental management, involving many and varied stakeholders.

- *Environmental issues and concerns are lowly rated in national priorities*. The fact, therefore, is that over time environmental degradation and intractable poverty have become more complex. Alleviating poverty and protecting the environment for sustainable development is not only necessary but also imperative. For sustainability, there is the need to maintain a balance between (i) maintaining a constant natural capital stock and environmental "sink" capacity and (ii) improving the quality of life through poverty alleviation.

- *The limited private sector participation in environmental management* has had negative impacts on the sector. Improving the level of private sector participation in environmental management to take economic responsibilities for damages done to the environment is critical. This would mean establishing a framework for proper environmental valuation of the activities of the private sector. The cost of environmental mitigation needs to be incorporated into the capital outlay as part of the Corporate Social Responsibility (CSR) of every private establishment.

- *Increasing conflicts over control and management of shared resources* are very common in many parts of Nigeria. For example, the Lake Chad region experiences perennial conflicts concerning access to its water and fisheries resources. This calls for a framework for a harmonized and common approach to the conservation and management of such shared resources.

- Finally, *Nigeria has a very high level of corruption* according to Transparency International reports known as Corruption Perception Index (CPI). This has consequences for investment and FDI flows to support Eco-innovation. Existing anti-corruption policies put into practice have been aimed at enforcement measures instead of tackling the root causes. The root or main causes of corruption in Nigeria have been recognized to include social insecurity and over-centralization of resources at the centre of government.

3.7 Eco-innovation Related Policies and Institutions in Zambia

3.7.1 Overview

The Republic of Zambia is a landlocked country in Southern Africa, surrounded by eight (8) countries: The Democratic Republic of Congo to the north; Tanzania to the north-east; Malawi to the east; Mozambique; Zimbabwe; Botswana; and Namibia to the south; and Angola to the west. The administrative and economic capital city is Lusaka (pop. 1.8 million)[19], located in the south-central part of the country. The population is concentrated mainly around Lusaka, south-eastern, the Copperbelt to the northwest and the main highway to the southwest till Livingstone. Zambia is resource-rich and for more than a decade (2000-2010) the country attained macroeconomic stability and achieved impressive real growth averaging 7.7% per annum and lifting Zambia above

[19] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Zambia_Country_Profile.pdf

the threshold of lower Middle-Income Countries. Economic growth is heavily dependent on the minerals sector, and in particular on and changes in the international price of copper.

Despite improvements in economic performance, poverty remains high and widespread, with 60% of the population still living below the poverty line while 42% lived in extreme poverty in 2010. Poverty prevalence is generally higher in rural and remote areas, but poverty is concentrated in urban areas. Urban poverty incidence could rise in the future as the urban population continues to grow while employment/self-employment opportunities are not created fast enough. In 2019, Zambia was ranked 146 out of the 188 countries on the HDI with a score of 0.584. The score has continuously increased since 2000. Zambia hosts the headquarters of the ***Common Market for Eastern and Southern Africa (COMESA)*** and remains active in the SADC. It is a founder-member of both groups. Zambia has also affirmed its commitment to inter-regional trade with the EAC to form the COMESA-EAC-SADC-tripartite integrated trade market with a combined population of 600 million and a total Gross Domestic Product of USD 1 trillion. This makes it an important country in the region to lead example given that the region highly depends on mining activities which contribute highly to environmental problems despite the high financial returns.

3.7.2 Enablers and/or constrainers of Eco-innovation in Zambia

The government of the Republic of Zambia has supported the formulation of policies and legislations that promote sustainable development [e.g., ***National Policy on climate change of 2016***, and ***the Seventh National Development Plan (2017-2021)***]. Zambia has developed a number of policies to promote sustainable development, which includes the ***Environmental Management Act of 2011*** and the Climate Change Bill which is currently under development. Others include Water and Sanitation Strategy, Seventh National Development Plan, and Vision 2030. To ensure transparency in the management of its natural resources, notably its copper resources, the country joined the Extractive Industries Transparency Initiative in October 2012.

The mining industry's contribution to government revenues has been low mainly due to attractive capital exemptions, initial low royalties and poor tax compliance. Management of natural resources is a key component of Eco-innovation and therefore increasing openness in its management is a positive step towards realizing sustainability and accountability. Zambia is a signatory to key International Treaties. It is therefore obligated to abide by the agreements and meet the international standards and obligations. For example, the ***1992 UN Convention on Biological Diversity, the Paris Agreement of 2015***, and the ***Kyoto Protocol (1997***) are among the treaties Zambia is a party to. These are largely in line with Eco-innovation as they support and enhance environmental sustainability. The country has also embraced partnerships with other countries. It has been implementing a number of projects in collaboration with other countries. An example is the Kavango-Zambezi transfrontier conservation project which is being implemented by five countries in southern Africa (Angola, Namibia, Botswana, Zambia, and Zimbabwe). The country has also put structures for involving the Private Sector. Therefore, the Small and Medium Scale businesses that promote Eco-innovation have a competitive advantage in Zambia.

The creation of a commission responsible for Science and Technology-***National Science and Technology Council (NSTC)***- is a clear indication of the Zambian Government's recognition of the importance of science and technology for our socio-economic development. However, a major constraint to the effective development and application of science and technology in Zambia has

been the lack of a clear Science and Technology Policy to provide guidelines for the development and application of science and technology. This has led to frequent changes in the ministry where STI is domiciled. This has led to confusion in the sector hence affecting its performance. It is, however, important to note that there are no explicit policies that promote Eco-innovation in Zambia. Although there are various articles and sections of the constitution of Zambia and various policies that are in tandem with the concept.

3.7.3 Eco-innovation related Policies and Frameworks in the Environment and Natural Resources Sector-Zambia

Environmental issues in Zambia have been the responsibilities of Government sector ministries until in recent years when institutional reforms and strategies are changing towards cross-sectoral coordination with increasing awareness on the significance, severity, cross-cutting and complex nature of environmental issues. Because of this, the Government as earlier stated, presently, is reviewing most environmental legislation to ensure that they are in line and consistent with current macro-economic reforms and the national environmental policy. The indulging reasons for the sectoral policy and legislation reviews are the need to balance economic growth with efficient and sustainable use of the environment and natural resources as well as the need to integrate environmental management in all sectors.

Sustainable natural resource management depends on enabling environmental laws that provide for various stakeholder participation. The Government is exploring the best ways of involving local people in managing the environment through community based natural resources programmes. The Government of Zambia (GoZ) has demonstrated increased commitment to addressing environmental and climate change concerns through its policies and strategies. Zambia has developed various environment and climate change-focused policies and strategies.

Zambia has made considerable progress towards the integration of economic, social and environmental analysis in the planning process as evidenced by the ***National Development Plans (NDPs).*** These Plans have key sectors and subsectors in the country that constitute the economic, social and environmental pillars. The policies and strategies are aligned with the Seventh National Development Plan and the Vision 2030, to promote "[a] prosperous middle-income country by 2030." Both support the advancement of low carbon and climate-resilient development pathways.

The National Policy on Environment (NPE) of 2007 was developed to synchronize and work across individual sectoral strategies that pertain to Zambia's environment and natural resources (e.g., agriculture, mining). The NPE, therefore, aims to fill a policy void and make it one holistic, overarching strategy to implement the Sustainable Development Goals for sustainable development by developing natural resources to spur development while conserving important resources and ecosystems (GoZ, 2007). This policy, therefore, has the core elements of Eco-innovation.

The National Climate Change Response Strategy (NCCRS) of 2010 seeks to develop a multi-sectoral strategy for Zambia in line with UNFCCC's objective to "stabilize greenhouse gas concentrations in the atmosphere." It has been developed to support and facilitate a coordinated response to climate change issues in the country. The Strategy enables Zambia to position itself strategically to respond to the adverse impacts of climate change and contribute to the achievement

of the overall objective of the UNFCCC, which it ratified in 1993. The NCCRS' vision is "a Prosperous Climate Change Resilient Economy". Whereas the mission is "to ensure that the most vulnerable sectors of the economy are climate proofed, and sustainable development achieved through the promotion of low carbon development pathways." By aiming to have the most sensitive economic sectors climate proofed, the NCCRS ensures that climate risks are addressed in the national development plans to minimize the adverse impacts of climate change and to ensure development effectiveness.

The National Investment Plan to Reduce Deforestation and Forest Degradation 2018-2022 is rooted in the policy environment of the country and it recognizes and contributes to achieving the goal of the national REDD+ Strategy, "to contribute to national reductions in greenhouse gas emissions by improving forest and land management and to ensure equitable sharing of both carbon and non-carbon benefits among stakeholders." Improved agricultural practices, forest conservation and management, sustainable management and utilization of forest resources and mining, appropriate energy sources and capacity development are thematic areas that speak to the multi-sectoral challenges of deforestation and forest degradation in Zambia (GoZ, 2018a). These interventions are in line with the Eco-innovation principles. The implementation of investments in these areas is expected to put Zambia on course towards its contributions to the SDGs to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The Investment Plan recognizes that options to reduce deforestation and forest degradation include strengthening and enhancing management and governance of forests at the local level taking into account the different needs of men, women, youth and vulnerable populations. It introduces measures to reduce the urban demand for charcoal, supporting the development of livelihood and income-generating activities that support or rely upon forest conservation and maintenance, and increasing the sustainability and efficiency of agricultural practices.

The potential and relative success of each of these strategies depend very much on the prevailing ecological, social, economic and political context in the landscapes in which they are implemented. These are key elements of Eco-innovation. It will equally contribute to the implementation of Zambia's NDCs to the implementation of the UNFCCC Paris Agreement on climate change, and most importantly, to national development objectives as expounded in the Vision 2030 and the Seventh National Development Plan (7NDP). Of particular interest, is the implementation of the landscape approach to the investment plan, where there are community-centred investments; inclusive decisions; integrated actions; it integrates high-value ecosystems' management and restoration; management of trade-offs; and it promotes long-term perspective, therefore, making it an eco-innovative approach.

Zambia has developed its ***National Adaptation Programme of Action on Climate Change of 2007*** by evaluating the impacts of climate change on the relevant sectors and using Multi-Criteria Analysis (MCA), has ranked the identified most urgent needs to prioritize ten immediate adaptation interventions. The sectors that were analysed are agriculture and food security (livestock, fisheries and crops), energy and water, human health, natural resources and wildlife. Zambia's NAPAs are based on a comprehensive assessment of climate-related hazards to the economy. It recognizes droughts, floods, extreme heat, and shorter rainy seasons as the major challenges to productivity and resilience of the agriculture sector and proposes pragmatic counter-

actions such as income diversification, increased use of irrigation systems, and improved post-harvest storage infrastructure.

Wetlands Policy of 2018 aims to ensure the wise use of wetlands and their resources, and create a comprehensive, stakeholder-based institutional and legal framework for their management. The specific objectives are to: promote the integrity and natural productivity of wetland ecosystems and the maintenance of their functions and values to conserve their biodiversity; promote their socio-economic development potential and contribution to the local and national economy; strengthen the legal and institutional framework for their management; promote a multi-sectoral approach to planning and management; develop public education and awareness; promote research, inventorying and monitoring of wetland resources; conserve wetlands; promote international action of national interest for the conservation of wetlands; restore degraded wetlands; promote community participation and ensure equitable sharing of benefits; provide training and strengthen the capacity of wetland conservation institutions; and promote "new" and created wetlands.

On the 3rd of March 2017, Zambia launched the ***National Climate Change Policy (NCCP) of 2016*** that aimed at stemming the impact of climate change and subsequent reduction of the country's annual economic growth due to crop failure and the impact of climate change on energy production. The NCCP is an important policy document that introduces a well-structured and coordinated national strategy to effectively tackle the adverse effects of climate change. The policy is driven by the Ministry of National Development and Planning, represents a document that was developed through a broad-based consultative process involving all key stakeholders to ensure stronger collaboration among the ministries that have a role to play in climate change mitigation and adaptation, and special consideration towards vulnerable groups such as poor rural women, children and the youth in Zambia (GoZ, 2016). These measures are intended to achieve coherence between successive NDPs and all climate change programmes. The multi-sectoral approach is an important ingredient for success in implementing projects and programmes because it is hinged on coordination through an established institutional framework. This is critical to achieving developmental goals through adaptation and mitigation interventions. The policy supports and facilitates a coordinated response to climate change by re-aligning its climate-sensitive sectors of the economy and society as required in the concept of Eco-innovation. The policy provides stakeholders with a clearer framework on how to tackle climate change in Zambia.

National Forestry Policy (NFP) of 2014: The specific policy objectives of this Policy are directly relevant to a National Policy on Environment, and they include (GoZ, 2014) ensuring the integrity, productivity and development potential of the forest reserves (especially through the involvement of stakeholders); ensuring adequate protection of forests, by empowering local communities and promoting the development and use of forest and non-wood forest products; sustainable management of forest ecosystems and biodiversity application through scientific and indigenous technical knowledge (through, inter alia, promoting the value of forests for catchment protection, biodiversity and ecosystem goods and services); ensuring sustainable management of forest resources for wood fuel production; recognizing and supporting the development of non-wood forest products; regulating exploitation and ensuring efficient use of forest resources and products, and ensuring gender equity in all aspects of forestry management, production and utilisation of forest products, extension training and education. An example of a change of attitude and behaviour amongst the community is provided in Box 10.

Box 10: The Green Living Movement (GLM) in Zambia

The Green Living Movement (GLM) of Zambia empowered communities with ecologically sound interventions that sustain productivity and respond to the needs of society. "I was among the people who used to cut down trees for charcoal burning…. But I have come to understand the devastating impact of deforestation. I also take time to share this information with friends." These are the words of Mwape village resident Derrick Daka that are now being repeated by many community members in eastern Zambia thanks to U.S.-Zambia cooperation to combat deforestation and climate change. Zambia has had one of the world's highest deforestation rates in the world – a problem that affects community members in areas losing forests, Zambia as a whole, and in fact the entire world.

https://slideplayer.com/slide/6904749/

Zambia's Second ***National Biodiversity Strategy and Action Plan (NBSAP -2) 2015-2025*** is a national cross-sectoral strategic document of Zambia whose main goal is to achieve that, by 2025, biodiversity is valued, conserved, restored and wisely used, as well as maintaining ecosystem services, sustaining a healthy environment and delivering benefits essential for all Zambians and the Zambian economy (GoZ, 2015). Specifically, more specific objectives of the document are: to address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society; to reduce the direct pressures on biodiversity and promote sustainable use improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity; and to enhance the benefits to all from biodiversity and ecosystem services. In the area of climate change, the NBSAP-2 provides for mainstreaming climate change adaptation measures that will enhance the resilience of priority ecosystems, as well as to regularize forest management plans to ensure connectivity, habitat resilience and ultimate refuges for wildlife in face of climate change. The ministry responsible for environment and natural resources, as a focal point on the Convention on Biological Diversity and also responsible for environmental policy, will be responsible for the overall coordination of NBSAP implementation in close collaboration with the National Steering Committee which was formed at the beginning of NBSAP1, the Zambia Environmental Management Agency, the ministry responsible Wildlife and National Parks, the ministries responsible for fisheries and other key stakeholder organizations active in the environment sector in general and biodiversity conservation in particular, will all play various roles. In order to effectively monitor and evaluate Zambia's NBSAP2 towards the Aichi Targets, the M&E framework emphasizes the balance between regular progress monitoring focusing on output level indicators and the achievement of established targets and periodic in-depth evaluation activities to examine whether outputs are leading to expected outcomes and impacts.

The National Environmental Action Plan (NEAP) of 1994 aims to integrate environmental concerns into the social and economic development planning process of the country. And the overall framework for natural resources management recognises the role of different interest groups including the local communities. To some extent stakeholder participation has been provided under revised sector legislation such as the Wildlife Act, Forests Act and the Water Act. The challenge, however, remains to translate the policy provisions into reality. The NEAP provided a framework for making significant changes needed to bring environmental considerations into the mainstream of decision making in Zambia. It provides an overview of

Zambia's environmental problems, existing legislation and institutions and strategy options for improving environmental quality (GoZ, 1994). The plan is based on a review of relevant studies and reports, local knowledge at the Provincial level, and a process of Consultant and discussion involving Central and provincial governments, academic institutions, governments, private sector, academic institutions, civic representatives, NGO's, International organisations and donor Community.

The Environment and Natural Resources Sector in Zambia has various actors that play different roles in promoting Eco-innovation in the country. They have been provided in Table 33 below.

Table 33: Eco-innovation relevant Institutions and actors in the Environment and Natural Resources Sector-Zambia

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Lands and Natural resources	The Ministry of Lands, Natural Resources and Environmental Protection will be the head in overseeing the implementation of this policy and will report to the Steering Committee of Permanent Secretaries. There will be a Technical Committee that will be chaired by the Permanent Secretary from the Ministry responsible for the Environment and Natural Resources. The following responsibilities will be assigned to the Ministry; • Developing/reviewing policies/legislation in consultation with • other stakeholders to facilitate the implementation of the NPCC; • Developing the policy implementation plan with other stakeholders; • M&E of the implementation of the policy in line with the mandate; • Coordinating the implementation of international agreements on climate change and; • Reporting to the Steering Committee of Permanent Secretaries on the progress of implementation of the policy.
Ministry of National Development Planning and coordination	The Ministry of National Development and Planning will be assigned overall coordination and mainstreaming of Climate Change in National development planning processes. The responsibilities of the Ministry are listed below; Facilitate mainstreaming of climate change activities in all sectors; M&E of implementation of climate change programs across sectors in line with the mandate; Support resource mobilization initiatives for Climate Change programs in the country; Ensure that climate change programs are complementary and result in positive impacts on the economy and livelihoods; Develop the implementation of Climate Change mainstreaming strategy; Report to the Council of Ministers on progress made on the implementation of Climate Change programs in the country.

The Ministry of Finance	Responsible for resource mobilization and the responsibilities will be as follows: Providing policy guidance on resource mobilization; Facilitating the acquisition of resources for Climate Change programs through innovative financial instruments;
The Council of Ministers	The Council of Ministers will be the principal decision-making body, overseeing Climate Change interventions in the country. It will be composed in the same way that the Council of Ministers responsible for disaster management as outlined in the Disaster Management Act No. 13 of 2010. The Permanent Secretary from the Ministry responsible for National Development Planning will be a Secretariat to the Council of Ministers. Roles & Responsibilities include providing policy guidance to: • Facilitate mainstreaming of climate change activities in National Development Plans and Sector Policies including the private sector and non-state actors; • Monitoring and Evaluation (M&E) and reporting; • Facilitate resource mobilization; • Ensure that programs are complementary, resulting in a sustained positive impact on the economy and livelihoods; and • The Steering Committee of Permanent Secretaries on Climate Change.
Steering Committee of Permanent Secretaries	The Steering Committee shall be the main advisory body to the Council of Ministers on policy and programme coordination and implementation. The Steering Committee of Permanent Secretaries shall be chaired by the Permanent Secretary in the Ministry responsible for National Development Planning. The composition of the Steering Committee shall include Permanent Secretaries from the ministries responsible for i. National Development Planning ii. Local Government iii. Health iv. Energy v. Agriculture vi. Environment and Natural Resources vii. Communications viii. Minerals Development ix. Information and Broadcasting x. Works and Supply xi. Home Affairs xii. Disaster Management and Mitigation xiii. Gender. Functions: • Overseeing the development/revision of appropriate policies, and legislation to facilitate the implementation of the National Policy on Climate Change as guided by the Council of Ministers in consultation with other stakeholders; • Ensuring the development of the Climate Change policy implementation plan, in collaboration with other stakeholders; • Overseeing the monitoring and evaluation of the implantation of the National Policy on Climate Change Policy Implementation Plan and report to the Council of Ministers through the Secretariat

	• Ensuring the implementation of international agreements on climate change and report to the Council of Ministers through the Secretariat) Reporting on progress of various programmes and projects related to Climate Change to the Council of Ministers through the Secretariat.
Climate Change Department	The Department sits in the Ministry responsible for Environment and Natural Resources. For purposes of coordination, overall oversight and mainstreaming of climate change in national development planning processes, this Department will closely collaborate with the Ministry responsible for National Development Planning. The responsibilities of the Department will include the following: • Facilitating the implementation of all climate change programmes/projects in all sectors in collaboration with relevant stakeholders; • Facilitating capacity building in institutions and agencies implementation Climate Change projects; • Facilitating the strengthening of climate change information systems; • Ensuring and /or providing technical backstopping on climate change programmes. • Ensuring monitoring and evaluation of the implementation of climate change projects in all sectors; • Reporting to government and other stakeholders on climate change Implementation; • Facilitating research in climate change; • Facilitating education and public awareness on climate change; and • Reporting to the Technical Committee on the implementation of Climate Change programmes/projects
Disaster Management and Mitigation Unit	The Disaster Management and Mitigation Unit will be responsible for the following: • Development and implementation of Climate Change related disaster preparedness and response programmes; • Conducting Comprehensive National Vulnerability Assessments and Risk Mapping; • Ensuring effective institutional structures and good governance on disaster risk reduction and adaptation; • Coordination of Early Warning activities related to Climate Change; and • Reporting to the Steering Committee of Permanent Secretaries on issues of Climate Change Adaptation and Disaster Risk Reduction related to Climate Change.

Zambia Environmental Management Agency (ZEMA)	• Advising the government and the private sector on environmental management and pollution control matters • Monitoring trends of natural resource usage and resulting impacts on the environment • Advising the Minister on declarations of protected areas and their management • Gathering and disseminating information to the public on environmental protection and pollution control • Initiating and promoting research, training & investigations in environmental management • Coordinating the implementation of activities of ministries & other authorities in environmental management • Conservation of biodiversity • Licensing undertakings and processes involving wastewater, hazardous waste, Ozone Depleting Substances and chemicals • Ensuring the integration of environmental concerns in national planning • Environmental management through tools such as SoE, NEAP, Environmental Management Strategies, EIA & SEA • Environmental protection and pollution control.

3.7.4 Eco-innovation related Policies and Frameworks in the Agriculture Sector- Zambia

The agricultural sector is the backbone of Zambia's rural economy and arguably the country's most important sector overall although it has been underperforming. Agriculture employs 56% of the Zambian population, serves the critical function of buffering employment volatility in other sectors, and remains key to ensuring food and nutrition security particularly for financially vulnerable communities. Agriculture is viewed as the backbone of the economy and as a sector that can support inclusive structural transformation, poverty reduction, and diversification of the economy away from copper. Climate change, however, is expected to exacerbate the vulnerability of economically marginalized farmer households and slow the growth of the sector. At the same time, the Land Use, Land Use Change and Forestry (LULUCF) sector and agriculture sector together account for approximately 94% of the country's carbon footprint. Taken this into account, ***the Climate Smart Agriculture Investment Plan (CSAIP)*** aims to identify and prioritize key investments and policy actions and to build capacity to operationalize country climate commitments toward a productive, resilient, and low-emissions agriculture sector. Zambia has ambitious goals and targets for its agriculture sector. At the same time, its goals are conflicting concerning the question of whether further forest land can be converted for agricultural purposes. This calls for further policy harmonization to achieve agriculture sector goals. The vision of the existing agricultural policy frameworks has, as its core, the aim of doubling productivity, while decreasing the country's current overreliance on maize, pursuing diversification, and boosting production and trade, which are expected to bolster food and nutrition security. The assessment showed that at least two strategy documents conflict with respect to land use: ***Zambia's Long-Term Vision for 2030*** calls for land under cultivation to expand by 0.9 million ha, whereas the

National Policy on Environment incorporates a target of sustainably intensifying land use without converting any additional land area into agriculture.

The National Agricultural Policy (NAP) of 2011 marked the beginning of strong partnership and teamwork between farmers, agribusiness, the public sector, civil society, and development partners. Each partner is expected to integrate the implications of ***the revised NAP 2012-2030*** objectives in their strategic plans and work plans. Timely and sustained implementation of the various action areas shall lead to significant increases in production, exports and reduction of food insecurity and poverty, especially among those who predominantly depend on agriculture. This will ensure that Zambia utilises the massive agriculture potential as a way of significantly contributing to the realisation of the national economic vision 2030. According to the NAP 2012-2030, the policy provides action areas to enable agribusiness to produce and commercialise in an environment with clear rules that are predictable and stable, with the government focusing on facilitating, supporting and providing incentives for productive activities (Government of Zambia [GoZ], 2011a). The NAP 2012-2030 policy objectives have included some elements of Eco-innovation such as inclusivity, sustainability, profitability and active participation of stakeholders. These are:

- Promote a sustainable increase in agricultural productivity of major crops with comparative advantage;
- Continuously improve agricultural input and product markets to reduce marketing costs and increase profitability and competitiveness of agribusiness;
- Increase agricultural exports as a way of fully utilising the preferential markets (regional and international) and increase contribution to foreign exchange earnings;
- Improve access to productive resources and services for small scale farmers, especially women and young farmers; and
- Continuously strengthen public and private sector institutional capabilities to improve agricultural policy implementation, resource mobilisation, agriculture research.

The National Livestock Development Policy of 2012 of Zambia was formulated to guide the effective implementation of activities and programmes in the livestock sub-sector. The livestock sub-sector contributes significantly to the agricultural industry in the country. It provides outputs such as meat, milk, eggs, hides, skins, manure, transport and draught power (GoZ, 2011b). The livestock sub-sector also generates employment opportunities and income among the rural people. The main thrust of the National Livestock Policy is increased production and productivity through improved disease control and animal husbandry practices. This is being done through the commercialization of livestock production activities, promotion of public and private sector partnerships and provision of effective livestock extension services that will ensure enhanced growth. Other aspects included in the policy are targeted subsidies for controlling diseases of national economic importance such as diseases of an epidemic nature and have transboundary significance. The other area of emphasis involves increasing overall production, productivity and management of marketable livestock and livestock products, especially in the traditional sector. Vector control is also being embraced as an important activity for minimizing or removing the risk of contracting diseases. The overall strategic principle is that farm-level disease control and production is the responsibility of livestock farmer who should buy the services, drugs, vaccines and inputs from the private sector. The role of government is limited to the control of epidemic, and infectious diseases, sanitary control and inspection and fighting pests and diseases beyond

farm level (e.g., Tsetse fly Control) (GoZ, 2011b). Furthermore, the use of low-cost communal methods e.g., Dips managed by users will be promoted.

The Climate Smart Agriculture Investment Plan (CSAIP) of 2019 aims to produce evidence of climate-smart agriculture (CSA) technologies that offer the greatest potential as Zambia seeks to sustainably increase productivity, enhance household and agro-ecosystem resilience, and reduce or remove its greenhouse gas emissions. Going forward, it will be critical to have an understanding of how best to address the trade-offs and synergies between achieving agricultural and economic goals on one hand and preparing for emerging climate challenges on the other. The CSAIP builds on existing strategy documents, including Zambia's 7th National Development Plan and its National Agricultural Investment Plan (See Box 11). Through a process that combines several modelling approaches, technology foresight, and consultations with stakeholders in the public and private sectors, civil society, and farmer groups, the plan hopes to answer these vital questions:

- Can CSA deliver on key agriculture sector indicators by 2050?
- Are CSA benefits robust across a range of climate change scenarios?
- Which CSA technologies should be prioritized for scale-up?
- Which strategies and investments will be critical to enable broad adoption of CSA technologies?

Innovative approaches are required to promote CSA adoption in Zambia and can help to overcome barriers in the enabling environment. Even though long-term household benefits incentivize CSA adoption at the farmer level, adoption remains low, often because information, skills and support to cover upfront costs are missing, inadequate access to finance, and lack of input and output markets.

> ***Box 11: Climate-smart agriculture (CSA) technologies in Zambia***
>
> Zambia's agriculture policy through the Climate-Smart Agriculture Investment Plan (CSAIP) is promoting/supporting Climate Smart Agriculture. The CSAIP aims to produce evidence of climate-smart agriculture (CSA) technologies that offer the greatest potential as Zambia seeks to sustainably increase productivity, enhance household and agroecosystem resilience, and reduce or remove its greenhouse gas emissions. Going forward, it will be critical to have an understanding of how best to address the trade-offs and synergies between achieving agricultural and economic goals on one hand and preparing for emerging climate challenges on the other. The use of evidence-based decision making is a key part of the process.
>
> https://www.preventionweb.net/publications/view/65303

Some of the key stakeholders in the agricultural sector in Zambia and their role in Eco-innovation have been provided in Table 34 below.

Table 34: Eco-innovation relevant Institutions and actors in the Agriculture Sector- Zambia

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Agriculture	• To effectively plan, monitor and evaluate agricultural sector programmes;

	• To promote agricultural production by providing policy guidelines to action programmes • To facilitate the policies that would ensure national and regional food security through dependable annual production of adequate supplies for basic foodstuffs at competitive prices; • To ensure that the existing agricultural resource base is well maintained and improved upon • To ensure that policies are formulated and implemented to facilitate the generation of income and employment to maximum feasible levels in all regions through full utilisation of scarce resources realization of domestic and export potential; • To provide policy and institutional framework that would contribute to sustainable industrial development; and • To ensure the contribution of the agricultural sector to the national balance of payments expands by among other things, providing incentives that would expand agricultural export in line with international comparative advantage.
Private Sector	The Private Sector will take a dominating role in driving the development agenda of the Agricultural Sector. In this regard, the government and the other stakeholders see a major role for the private sector in all the Investment Programmes. However, it needs to be recognized that the country is coming from a background where the government dominated the running of the economy. This implicitly left a weakened private sector that needs considerable capacity building for it to effectively undertake its rightful role as an engine to propel the sector's growth.
Local Government	The Local Governments (at provincial and district levels) will offer investors in all the Investment Programmes incentives for identified ventures that are socially and environmentally sustainable. They will offer the necessary incentives for a heightened private sector is driven agricultural development agenda within their respective boundaries within the jurisdiction that presents a "win" for communities, LGs and the investor. Local governments will negotiate terms and conditions for concessions or contracts for management of infrastructures including Built, Own Operate and Transfer (BOOT) investments. They will ensure the availability of socially and environmentally feasible sites for resource development and use within their districts or provinces.

The communities, community groups	The communities, community groups or community-based institutions will participate in negotiating terms, conditions and concessions for investments to ensure community concerns are addressed including, participating in recurrent monitoring and oversight of investments to ensure it aligns with community interests. The Participatory Monitoring and Evaluation (PME), which has been tested and proven during the implementation of the Zambia Social Investment Fund (ZAMSIF), will be used by communities for tracking implementation progress and impact of various interventions within community boundaries. Communities will provide services and labour forces required by local investments and generally take advantage to acquire new skills introduced by investors.

3.7.5 Eco-innovation related Policies and Frameworks in the Energy Sector- Zambia

The National Climate Change Policy of 2016 emphasizes the integration of economic development programmes such as forestry, energy and agriculture with climate change as a priority. One way Zambia is promoting green growth or Eco-innovation is through the use of environmentally friendly sources of energy such as hydroelectric, geothermal, solar, wind, biomass, and biofuels. Environmentally related tax revenue is also another means to promote green growth. It is expressed as a percentage of GDP. The taxes include energy products for transport purposes (petrol and diesel) and stationary purposes (fossil fuels and electricity); motor vehicles and transport (one-off import or sales taxes, recurrent taxes on registration or road use and other transport taxes); waste management (final disposal, packaging and other waste-related product taxes); ozone-depleting substances and other taxes. Zambia has also cooperated with various stakeholders such as the European Union and the United Nations to promote clean energy and green growth. The EU-UNDP Low Emission Capacity Building Programme (LECBP) was launched as part of a collaboration between the European Union (EU - European Commission and the Member States) and the United National Development Programme (UNDP). Efforts are also focused on reducing the demand for charcoal by providing alternative fuel sources and fuel-efficient technologies like gel fuel and cookstoves.

The National Energy Policy of 2008 sets out the Government's intentions aimed at ensuring that the energy sector's potential to drive economic growth and reduce poverty is harnessed. This policy document, therefore, guides policymakers, decision makers and development managers in the government, private sector, NGOs, civil society, on Government's intended actions in the energy sector (GoZ, 2008). Some of the key issues that have emerged from the policy review include the need to recognise the cross-cutting nature of energy. Critical social and economic services like health and education, transport and commerce cannot be efficiently and effectively provided in the absence of reliable and affordable energy services. The new energy policy further takes account of important issues such as the high incidence of poverty, the HIV/AIDS pandemic, gender, environment and household energy, rural electrification and the role of biofuels in Zambia's future energy mix. The policy supports the development of RETs. It was adopted to remove barriers to the development of renewable energy capacity in the country. Measures to achieve barrier removal include: ensuring the availability of data and information on market demand, resource assessment and applicability of RETs; strengthening the institutional framework for Research and Development, and promotion of RETs; providing appropriate financial and fiscal

instruments for stimulating the implementation of RETs; continuing promotion, enhancement, development and deployment of RETs; raising public awareness of the benefits and opportunities of RETs and developing the capacity for their implementation and promoting RETs for electricity generation. The policy has outlined measures that are aimed to address issues that include: the reduced consumption of wood fuel, increasing utilisation of renewable energy sources, reduction of GHG emissions from the energy sector and promotion of energy management. See Table 35 for key stakeholders and their role in Eco-innovation.

Table 35: Eco-innovation relevant Institutions and actors in the Energy Sector-Zambia

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Energy and Water Development	• Formulating national energy policies, in consultation with other stakeholders and coordinating the activities and operations of energy sector agencies and ensuring the proper management and development of the energy resources per the guiding principles under this Policy; • Implementation of the National Energy Policy; • Coordination of all policy implementation functions; • Develop, in collaboration with other stakeholders, a National Energy Strategy and Plan; • Monitor and evaluate the implementation of the strategies specified by the various Ministries relating to energy; • Take the lead role in developing new energy-related programmes, projects and activities; and • Ensure that all cross-sector issues are addressed by respective institutions
Zambia Rural Electrification Authority	REAs mandate is to provide electricity infrastructure to all rural areas using appropriate technologies to increase access, productivity and contribute to improved quality of life.

3.7.6 Eco-innovation related Policies and Frameworks in the Trade & Industry Sector-Zambia

Zambia's sustainable Commercial, Trade and Industrial (CTI) reform policies were adopted in 1994 under the Industrial, Commercial and Trade Policy. This policy sought to advance Zambia's achievements and to promote a dynamic environment based on growth and productivity. The CTI Policy covered both issues of Trade and Industrial Development. The policy was aimed at developing an enabling economic environment in Zambia that supported private investments, enabled the development of domestic productive capacities, and contributed to the expansion of Zambia's international trade. The Industrial component of the CTI policy anticipated an expanding manufacturing sector base and diversification of the economy. A review of the CTI Policy revealed that the industrial sector had underperformed and there were gaps in the policy. These were mainly related to the failure to adequately address specific policy objectives/strategies such as capacity building for local firms to produce competitively both for the local and international markets; provision of Business Development Services to MSMEs and the enforcement of compulsory standards. This led to the development of two separate policies that cover Trade and Industry separately.

The Ministry of Commerce, Trade and Industry, works closely with the Ministry of Finance and National Planning. National Associations concerned with Commercial, Trade and Industrial sector development, the Zambia Revenue Authority and other line economic institutions to develop a conducive environment for trade and industrial development. Other regulatory instruments used in this sector and their roles are provided in Table 36 below:

Table 36: Relevant Acts and their roles in the Trade and Industry Sector in Zambia

Legislation / regulation	Roles played in Eco-innovation
Competition and Fair-Trading Act	Regulates the market to ensure fair trading practices and prevent market domination through the Competition Commission.
Investments Act	Regulates, Promotes and monitors foreign investment coming into the country through the investment centre.
SED Act	Promotes SME Development. Allows the SED Board to put in place measures to assist SME's through incentives and grants.
Standards Act	Provides the legal framework for regulating and enforcing standards.
Companies Act	Regulates company formation, corporate governance and the company operation in Zambia.
Trade Mark Act	Regulation and protection of trademark use.
Privatisation Act	The legal framework for the establishment and operation of the Zambia Privatisation Agency. Gives guidelines and modalities for the privatisation of state-owned enterprise.
Patents and Designs Act	Regulates and protects Intellectual Property Rights.
Trade Licensing Act	Administered by local authorities. The legal framework for authorising and regulating formal trade.

The GoZ has embarked on trade expansion in support of Zambia's industrialisation agenda and the promotion of sustainable growth and development. ***The National Trade Policy (NTP) of 2018*** is anchored on Zambia's aspiration of becoming a prosperous middle-income economy by 2030, as set out in the Vision 2030. This Policy document builds on the 2009 Commercial Trade and Industrial Policy, which has since been revised and separated into two documents, the National Industrial Policy and the NTP to align with the changing policy environment, nationally and globally. The NTP outlines measures aimed at tackling trade-related constraints, intending to promote production for export as part of the broader national agenda to diversify the economy. Specific focus is placed on improving the trade environment and Zambia's competitiveness in the domestic, regional and global economy (GoZ, 2018b). The Policy further recognises the complexities associated with regional and multilateral trade arrangements. The NTP will guide the engagement in such arrangements to ensure that adequate policy space is secured at the national level to pursue initiatives that promote the development and growth of productive sectors. Other aspects covered in the policy are Tariff and Non-Tariff Measures, Competition and Consumer Welfare, Local Empowerment and Participation, Local product/services promotion, Intellectual property rights etc. Unfortunately, the NTP has no mention of environmental sustainability or Eco-innovation.

The National Industrial Policy (NIP) of 2018 sets out the Government's approach to the industrial development of the country. It spells out guidelines that will inform the implementation of the Government's industrial development agenda, with particular reference to the growth, diversification, upgrading and competitiveness of Zambia's manufacturing sector. The NIP is expected to drive the transformation process which will assist the country to deliver sustainable jobs, equitable growth and widespread poverty reduction (GoZ, 2018c). The Industrial Policy is directly linked and aligned with other National and Sector Policies to ensure smooth and coordinated implementation of the agenda to transform the economy in line with Vision 2030. In addition, this policy is in line and conforms with regional policies such as the COMESA and SADC Industrial policies. The policy is guided by four (4) principles of inclusivity, Realism and Implementability, Responsiveness and Policy Predictability. However, there is no mention of environmental sustainability or Eco-innovation. The key players in the Trade and Industry Sector and their role are provided in Table 37.

Table 37: Eco-innovation relevant Institutions and actors in the Trade and Industry Sector-Zambia

Name of institution/ actor	Roles played in Eco-innovation
The Ministry of Commerce, Trade and Industry (MCTI)	The Ministry of Commerce, Trade and Industry will be the primary government institution responsible for monitoring the implementation of the NTP. Implementation of the NTP will be done through its statutory bodies and in collaboration with other line ministries and agencies. The Ministry oversees the activities of various Statutory Bodies and Agencies under its jurisdiction that are responsible for the implementation of the policy.
The Zambia Development Agency (ZDA)	The mandate of ZDA is to promote and facilitate investment; Provide support to micro and small business enterprises; Promote exports and market development; Provide market intelligence to the business community and; Promote and encourage education and skills training to increase productivity in business enterprises.
The Patents and Companies Registration Agency (PACRA)	The mandate of PACRA is to implement the legal and regulatory framework for business registration, protection and use of intellectual property rights through which businesses can be established and be able to conduct their commercial transactions.
The Competition and Consumer Protection Commission (CCPC)	The mandate of CCPC is to enforce competition and consumer protection legislation; and Initiate and support relevant research within the field of competition and consumer welfare, among others.
The Zambia Bureau of Standards (ZABS)	The mandate of ZABS is to promote quality product assurance in industry and commerce; and development of Zambian standards and promote their use.
The Zambia Weights and Measures Agency (ZWMA)	The mandate of ZWMA is to administer all matters relating to weighing and measuring, Verification, Testing and approval of new types of weighing and measuring instrument used for trade to ensure compliance with international and national standards; as well as the establishment of laboratories and other facilities to improve maintenance, storage and testing of trade measurement standards, among others.

Kaizen Institute of Zambia (KIZ)	a. Providing effective KAIZEN deployment through education, training and consultancy; b. Providing integrated capacity building for human resources; c. Enhancing higher discipline by creating a consistent approach to tasks and procedures; and d. Enhancing management systems through the introduction of total quality management and international quality management systems.
The Citizens Economic Empowerment Commission (CEEC)	The mandate of CEEC is to promote access to affordable finance to targeted citizens; Encourage effective and meaningful participation of targeted citizens in the economy to contribute to sustainable economic growth; Mobilize resources for economic empowerment programs; and Monitor and evaluate economic empowerment initiatives, among others.
The Business Regulatory Review Agency (BRRA)	The mandate of BRRA provides a set of principles and interventions to guide regulatory agencies when regulating and licensing business activities; establish an e-registry and assign a control number for laws regulating business; and provide for the establishment of regulatory services centres, regulatory clearance systems and a single licensing system for business in each sector or group of businesses in a sector; among others.
Regulatory Authorities	(a) Support a conducive macroeconomic environment by containing inflation levels and ensuring a favourable exchange rate to support local manufacturing and exporting; and (b) Implement efficient licensing regimes and procedures that will facilitate the growth of the manufacturing sector.
Industrial Development Corporation (IDC)	IDC will play the critical role of supporting the establishment of new industries, investing in rural development and other areas that may not be attractive for private sector investment. IDC will be mandated to profitably and efficiently spearhead investment and promote value addition in all priority sectors listed in this policy. IDC will also lead in promoting rural industrialisation by investing in value-adding ventures utilising available local resources. Further, IDC will catalyse investment in support sectors such as infrastructure, health, education, energy and finance.

3.7.7 Eco-innovation related Policies and Frameworks in the Transport and Infrastructure Sector-Zambia

Infrastructure serves as a central delivery mechanism in achieving sustainable economic development and in the generation of quality social-economic development in the country. Infrastructure remains a major challenge to growth, economic diversification and human development in Zambia. Further, Zambia is a land-linked country centrally positioned between eight (8) neighbouring countries that are increasingly trading amongst each other to optimize economic benefits. Furthermore, major import and export trade corridors to facilitate economic integration among SADC and COMESA member countries pass through Zambia. As such, Infrastructure development, is one of the Government's priority areas, and is upheld in the National

Development Plans and ***the National Vision 2030***. Transport infrastructure covers roads and bridges, railways, airports and aerodromes and maritime and inland waterways. The state of transport infrastructure, however, remains inadequate to sustain and match the desired levels of growth due to weak structural and management capacity resulting in over commitments, high cost of construction and low investment. The government has embarked on a program to improve the infrastructure at all the international airports. This is being done in collaboration with private sector participation. The developments include the runways, terminals and auxiliary facilities in and around the airports such as hotels, shopping malls, conference facilities etc.

The Ministry of Transport and Communications reviewed ***the National Transport Policy of 2002*** to ensure that it responds to emerging challenges of transport infrastructure and service provision. Several domestic, regional and international economic and social issues have emerged since the adoption of the Policy in 2002. The thrust of ***the National Transport Policy (NTP) 2019*** is to create an intermodal transport system that will provide for interlinkages among the four modes (Rail, Road, Air and Water) of transport and ultimately transform Zambia into a regional transport hub by 2028 (GoZ, 2019). The Policy will further introduce institutional reforms in the transport sector for improved implementation capacity and greater coordination at all implementation levels. The guiding principles of the NTP include partnership, inclusive stakeholder participation, accountability and Transparency, Equity and Social Justice, Decentralization, Universality and Sustainability. Find below (Table 38) the key stakeholders in the Transport Sector and their role in Eco-innovation.

Table 38: Eco-innovation relevant Institutions and actors in the Transport and ICT Infrastructure Sector in Zambia

Name of institution/ actor	Roles played in Eco-innovation
The Ministry of Transport and Communications	The Ministry of Transport and Communications will take the leading role in the coordination and implementation of this Policy.
Ministry of Home Affairs	Will provide security of transport infrastructure and ensure compliance to road safety regulations
Ministry of Finance	• Facilitate in designing Public-Private Partnership (PPP) • Resource mobilisation for transport infrastructure development • Management of Grants and Loans related to the transport sector
Ministry of Local Government	• Manage local road authorities • Responsible for transport management in the local authority • Coordinate District Motor Vehicle licensing • Management of District Aerodromes
The Inter-Ministerial Committee	The Committee will assist in promoting socio-economic development and growth through transport facilitation. The efforts of the stated Line Ministries will be complemented by the Transport Management Initiative Committee of Ministers and the Transport Sector Advisory Group.

3.7.8 Eco-innovation related Policies and Frameworks in the Science Technology and Innovation Sector-Zambia

The importance of research and development of technologies for sustainable development in the country need to be emphasized. In recognition of this significance, several institutions are presently involved in environmental research and management. These institutions have also been encouraged to collaborate and wherever possible carry out joint research activities with neighbouring countries and international organizations. The Ministry of Tourism, Environment and Natural Resources, for example, is spearheading research in fields such as pollution monitoring and control methods, watershed management, energy-saving and tree development. Other institutions involved in environmental research include the University of Zambia, National Institute for Scientific and Industrial Research (NISIR), Water Sector, Energy Sector, Zambia Wildlife Authority and Ministry of Agriculture, Food and Fisheries through various sector programmes. The Technology Development Unit of the University of Zambia in collaboration with the Energy Department and NISIR has carried out studies that would make solar, wind and biogas energy accessible to the local people. These institutions have continued to develop the necessary technology that will save the country from high costs and minimize the polluting effects of oil and coal. The transformation of Zambia's economic policy framework, in 1992 from a Central State-controlled to a free market and liberalized economy, with greater emphasis on private sector participation in the economy, brought some beneficial results in some sectors of the economy and some negative results in other sectors, such as manufacturing industry, which faced stiff competition from imported goods and services. A major contributing factor to the poor performance of the industry has been the lack of application of science and technology, which has resulted in industries becoming uncompetitive with declining productivity under the global trade environment.

In view of the above, the government realized that sustainable socio-economic development can only be achieved through a strong well-coordinated and monitored science and technology system. Hence, the government decided to formulate the ***National Science and Technology Policy of 1996***. The mission of the policy on Science and Technology is to promote and exploit science and technology as an instrument for developing an environmentally friendly indigenous technological capacity in sustainable socio-economic development to improve the quality of life for Zambians (GoZ, 1996). The goals of the Policy are: - to enhance linkages between technology research institutes, the private as well as the public sector to encourage demand-driven research and development; develop and sustain a national scientific and technological capacity and provide highly skilled human resource for increased productivity in the economy; foster national and international linkages for enhanced technology transfer; and facilitate the acquisition, adaptation and utilization of foreign technology.

The Science and Technology Act No.26 of 1997 established NSTC with the mission to enhance Zambia's capacity for scientific research and technological development. The overall function of NSTC is to promote science and technology, create wealth and improve the quality of life in Zambia.

Figure 7 shows the public sector institutional chain involved in the National Innovation System (NIS) in Zambia post-1996. Ministry of Science, Technology and Vocational Training (MSTVT)

was originally in charge of overseeing STI and vocational training until 2015 when the Ministry of Higher Education assumed the responsibility. NISIR, NTBC and various research departments found under the line ministries are supported by NSTC. The framework is a top-down approach where the government has more authority in mandating how STI is applied (Daka and Toivanen, 2014). Table 39 below provides the roles of the different players in the STI sector in Zambia.

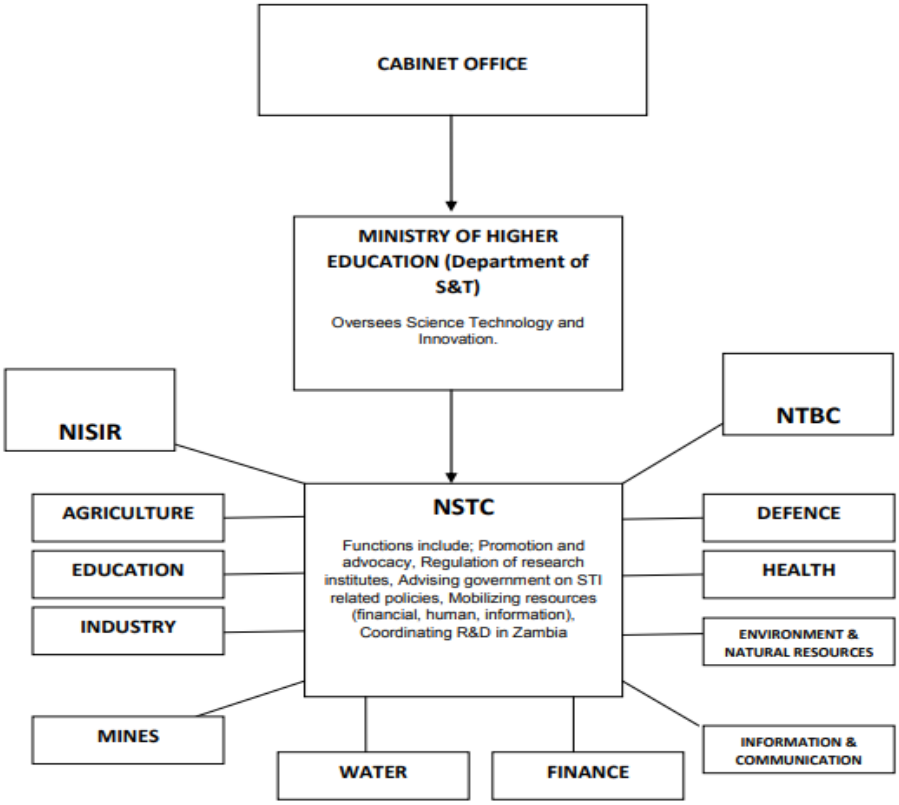


Figure 7: Institutional Innovation Chain in Zambia

Table 39: Eco-innovation relevant Institutions and actors in the Science Technology and Innovation Sector-Zambia

Name of institution/ actor	Roles played in Eco-innovation
Ministry of Higher Education	Implements the Science and Technology Policy of 1996 through the Department of Science, Technology and Innovation. The Department is mandated with policy formulation, interpretation, coordination and provision of guidelines for all Science, Technology and Innovation providers through promotion and application of research, development, commercialization and transfer.
National Institute for Scientific and Industrial Research (NISIR)	NISIR formerly known as National Council for Scientific Research (NCSR) is a government institution set up by the Science and Technology Act No. 26 of 1997 through the Statutory Instrument No. 73 of 1998. It has unique laboratory facilities and experience is a leading research and development institution in Zambia and has a proven

	track record of developing technologies and offering quality analytical laboratory and other services that can be exploited by small and medium scale enterprises that normally have no research and development facilities of their own for mutual benefit.
Parliamentary Committee responsible for Science and Technology	There shall be a Parliamentary Committee responsible for Science and Technology. Its functions shall be: - • To monitor the performance of the implementation of Science and Technology policies, programmes and activities. • To sensitize members of parliament on the importance of Science and Technology in national development
Cabinet Committee on Science and Technology	There shall be a Science and Technology Committee of Cabinet which will carry out the following functions: - • Advise the Government on policies, programmes and activities in Science and Technology • Harmonise Government policies that pertain to Science and Technology in industry, trade and commerce and environment.
The National Science and Technology Council (NSTC)	Specific functions of the council include: • Promotion and advocacy in the development of indigenous technological capacity • Using science and technology in industry, as well as the initiation of special projects for the promotion of science and technology • Coordinating all forms of scientific and technological research and innovation • Regulating research in science and technology, including the registration of research and the relevant research and development institutions • Mobilizing and making available financial, human and other resources including science and technology information to research and development institutions
Research Institutes	• Conduct research and development in identified key areas of national development • Disseminate research findings. • Liaise with other research bodies within and outside Zambia. • Review research activities in areas of competence. • Receive and raise funds for research in identified key areas. • Establish and maintain relationships with corresponding scientific institutions in other countries
Technology Business Centre (TBC)	• Facilitate the acquisition of technology to entrepreneurs to help them set up their own business. • Assist Research Institutes including universities and technical colleges and make links with industry clients to sell the Research Institutes research expertise and prototypes on the shelf on their behalf.

	• Provide advisory service in Engineering and process design that will accompany the marketing work and to assist prototype work to go into industrial production. • Act as liaison institution by promoting linkages among researchers, bankers and businessmen on the issue of new technology-based development; and • Evaluate the relevance of imported technology and assess its environmental impact.

3.7.9 What works, what doesn't work and why in Zambia

The existing policies in Zambia could be used to guide Eco-innovation development without necessarily developing new ones. Furthermore, Eco-innovation can be implemented under the respective sectors guided by the existing policies or by revising them to strongly feature Eco-innovation aspects. Below are some of the initiatives and actions that have worked to support Eco-innovation development as well as those that have worked to derail efforts of sustainable development.

3.7.9.1 What works and why

a) Commitment to the implementation of various Regional, National and International Environmental Policies, Conventions and Treaties

Supporting policies and strategies: Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 1983, United Nations Convention to Combat Desertification (UNCCD), Lusaka Agreement on Co-operative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora, Paris Agreement, Ramsar Convention, SADC Protocol on shared Water Resources, Kyoto Protocol of 1997, Zambezi River Commission agreement, the Environmental Management Act of 2011, Seventh National Development Plan, Second National Biodiversity Strategy and Action Plan (NBSAP -2) 2015-2025, the National Climate Change Response Strategy (NCCRS) of 2010, the National Adaptation Programme of Action on Climate Change of 2007, the National Climate Change Policy (NCCP) of 2016, the National Environmental Action Plan (NEAP) of 1994, the National Agricultural Policy (NAP) of 2011, the Climate Smart Agriculture Investment Plan (CSAIP) of 2019, the National Energy Policy of 2008, National Science and Technology Policy of 1996, the Science and Technology Act No.26 of 1997 and Vision 2030.

Description and Impact: As a signatory to several International Treaties, Zambia is obligated to meet international standards and requirements especially with regards to environment and natural resources conservation. For example, the 1992 UN Convention on Biological Diversity, the Paris Agreement of 2015, and the Kyoto Protocol of 1997 being among key treaties ratified by Zambia. Some of these agreements are also regional and therefore, Zambia is also cooperating with other countries especially the neighbouring countries in the implementation of regional projects and policies. These commitments, more so, those enhancing environmental sustainability bide well with mainstreaming Eco-innovation aspects. Some of these projects have contributed significantly to the development of structures and infrastructure as well as in building the capacity of officers implementing them. Implementing the Paris Agreement for instance requires setting up various frameworks across the five components of NDCs (Finance, MRV, Adaptation, Mitigation and Governance). Zambia has managed to develop the NDCs and has prepared the first and second

national communications, therefore, demonstrating that they are better equipped in the implementation of environmental initiatives and projects.

Several policies and strategy documents have been developed across different sectors in Zambia with consideration of the environment and climate change in mind. The enactment of the climate change policy of 2016 for instance has allowed for a multi-sectoral approach to environmental sensitivity. It has led to the integration of climate change into other key national policies and programmes, as well as ensuring the policies are implemented. Some of the Acts of parliament have led to the creation of various institutions that play certain critical roles. The creation of dedicated institutions for the implementation of the policies has been working well. For instance, the creation of the National Science and Technology Council (NSTC) that compels annual registration of R&D by research Institutions.

Reasons for success:

- A strong inclusion of capacity building components in the implementation process.
- Strong commitment by government and its lead agencies as well as the incorporation of the private sector and civil society.
- Growing support from civil society, the private sector and international bodies.
- Increased understanding by the various players on the important role played by the environment in the economic development of Zambia.
- Setting up institutions whose role is to ensure that all environmental considerations have been observed before implementation of projects.

b) Collection and the use of data on environment and economic development

Supporting policies and strategies: The National Policy on Environment (NPE) of 2007, Wetlands Policy of 2018, National Climate Change Policy (NCCP) of 2016, National Forestry Policy (NFP) of 2014, Second National Biodiversity Strategy and Action Plan (NBSAP -2) 2015-2025, the National Environmental Action Plan (NEAP) of 1994, the National Agricultural Policy (NAP) of 2011, the Climate Smart Agriculture Investment Plan (CSAIP) of 2019, the National Energy Policy of 2008, National Science and Technology Policy of 1996 and the Science and Technology Act No. 26 of 1997.

Description and Impact: Zambia is dependent on natural resources: agriculture, wildlife and minerals are all central to economic growth, making the balance between economic development and environmental sustainability particularly important. Policymakers in Zambia, increasingly recognize the link between environmental quality and economic growth. High levels of pollution harm human health and lower human capital accumulation, rapid deforestation contributes to erosion and desertification, with negative implications for hydroelectricity and agricultural output while habitat loss hurts ecotourism revenue. Unreliable energy and water supplies also interfere with firm growth. These links are highly relevant, and navigating each one successfully is crucial to the country's long-run growth. However, a paucity of data hinders rigorous research efforts, both quantitative and qualitative, on these relationships and their ultimate effect on economic growth.

Identifying and accessing data is a time-intensive activity, that requires significant in-country effort and stakeholder management. Before the formation of this database, significant barriers to

entry existed for research on environmental and economic relationships. This project constructed a database of environmental policies and regulations and their implementation to provide a baseline for more research on the impacts of environmental quality on economic outcomes and, in turn, the effects of rapid development on environmental quality. The goal is for this database to serve as a resource for further investigation by a wide variety of researchers and the Government of Zambia and to serve as a template for similar database development in other sectors and/or other countries.

Reasons for success:

- The increasing demand for data from various stakeholders including ZEMA and public and private research institutions. Previously data were scattered and at times unavailable despite the responsible institutions have the sole responsibility for keeping records.
- It complements other international conventions such as the Paris Agreement-NDC implementation. The MRV component of NDCs requires elaborate monitoring and evaluation systems for measuring and recording data.
- There is increasing participation of academic, research institutions, for example, Copperbelt University that has initiated various environmental/energy programmes. The private sector has also increasingly interested in these initiatives.

c) Mainstreaming of Environmental issues in Development plans and initiatives

Supporting policies and strategies: National Decentralisation Policy of 2004, National Conservation Strategy (NCS) of 1985, the Environmental Management Act of 2011 and the National Environmental Action Plan (NEAP) of 1994 among other regional and international conventions and treaties such as the Paris Agreement, CITES, CBD etc.

Description and Impact: There is an increasing political will to support environmental conservation as well as mitigating and adaptation against climate change vagaries and implementation of related policies thereby increasing chances for support of Eco-innovation. This has been demonstrated by the increasing mainstreaming of environmental aspects in policies and development plans in Zambia.

The National Conservation Strategy (NCS) of 1985 was the first major Zambian environmental mainstreaming initiative. It was the first initiative to promote the environment as a positive foundation for development. Previous environment initiatives had tended to focus on preserving nature from the impacts of development. It was an early multi-sector, multi-disciplinary assessment and planning process – drawing on government-wide consultation and placing business, NGO and scientific inputs on an equal footing with government. Previous multi-sector work had primarily been limited to the national development planning process. It was also one of the first national conservation strategies in the world-translating the principles of the ground-breaking 1980 World Conservation Strategy, produced by UNEP, WWF and IUCN, into policy and plans relevant to Zambia. Prior to this, the concerns of environmental groups had not been elevated to issues of national development policy. NCS helped to do this by promoting three ecological principles for development-sustainable use of natural resources, maintaining ecological processes, and protecting biodiversity. It promoted many sustainable development concerns that are now commonplace, including climate change, the need for community participation in using the environment sustainably, and the need for safeguards such as EIA in development planning.

Many Zambian initiatives for environmentally sound development can trace their origins back to NCS. As a pioneer, however, NCS was itself perhaps a step too far ahead and did not become part of the mainstream planning process. Mainstream change relied more directly on several initiatives that were identified and inspired by NCS. For example, the Environmental Protection and Pollution Control Act (EPPCA) of 1990 and the Environmental Council of Zambia (ECZ) were recommended and outlined by NCS. They introduced procedures such as EIA, to better handle environmental issues. This path was also paved by NCS calling for new environmental planning capacity in the then National Commission for Development Planning, and supporting EIA training.

Zambia's National Decentralisation Policy of 2004 retains central government powers of general policy formulation, monitoring and implementation. But it devolves implementation, use of assets and monitoring to the provincial level; and, further, management of natural resources, service delivery (including environmental services and water and sanitation), and disaster management to the district level. However, the process of achieving decentralisation has been slow. Most funds, functions and public services are still delivered by the local offices of central government institutions – extending further the silos that have hindered an integrated approach at the national level. Furthermore, most national policies predate the decentralisation policy and underplay the potentials of planning at the district level and involvement of the private sector in service delivery.

Reasons for success:

- Increasing participation of various stakeholders such as the private sector, civil society, the media and development partners.
- Increased sensitization on the importance of environmental considerations in all sector development initiatives, programmes and policies.
- Establishment of various sectoral bodies/institutions that have specific mandates for ensuring environmental compliance and sustainability.

3.7.9.2 What doesn't work and why

Some of the main reasons why various Eco-innovation related initiatives and projects have not been very successful in Zambia include:

- *Limited knowledge of Eco-innovation is a major setback in Zambia*. Very few people understand the concept and hence are not able to develop or identify technologies, products, and services that support Eco-innovation. Also, because of high illiteracy levels, people are limited in the scientific interpretation of innovations and quality control.
- *Inadequate education and research facilities, especially in public research facilities.* The right infrastructure and laboratory equipment is vital for eco-innovators to efficiently and effectively carry out research and training. Currently, few institutions provide training related to Eco-innovation. This is partly due to the low capacity in the research institutions about Eco-innovation. Eco-innovation is a relatively new concept and education has not been focusing on it until recently where related concepts such as green growth and green economy are emerging. As a result, few people have the expertise in Eco-innovation.

- *There are limited customers for Eco-innovation products and services due to limited knowledge of these Eco-innovation technologies* as well as the relatively higher costs hence

leading to poor markets for products that otherwise would have long term benefits to the country and businesses.

- *Inadequate Intellectual Property Rights (IPR) policy.* This has discouraged the development of Eco-innovations and valuable technologies as innovators are not guaranteed the security of their products and lead to limited remuneration and benefits for the innovator. The development of Eco-innovation requires investment in research infrastructure and support from experts.

- *Lack of sufficient research funds*- Zambia has a shortage of funds to support research and commercialization of research outputs that are Eco-innovative.

- *There are some contradicting policies across the various sectors that need harmonizing.* This has led to poor coordination and implementation of policies that promote Eco-innovation. For example, the Forestry Policy versus Agricultural Policy. The Forestry Policy advocates for sustainable management of forests while the Agriculture Policy (in terms of commercial farming) advocates for massive forest area clearing for agriculture purposes which predisposes the land to degradation. The fragmented policy framework has diluted various policy provisions on Eco-innovation in different sectors that pose challenges in the effective driving of Eco-innovation.

3.8 Global Innovation Index Ranking and its implication to Eco-innovation Development

The *"Global Innovation Index (GII) provides detailed metrics about the innovation performance of 129 countries and economies around the world. It uses 80 indicators that explore a broad vision of innovation, including political environment, education, infrastructure and business sophistication. For more than a decade, the GII has fostered national innovation strategies and international debates on innovation in three main ways. First, the GII helps place innovation firmly on the map for countries, in particular for low- and middle-income economies. Second, the GII allows countries to assess the relative performance of their national innovation system. A significant number of countries work hard to 'unpack their GII innovation ranking' and to analyse their innovation strengths and weaknesses. These findings then inform innovation policies and actions. Third, the GII provides a strong impetus for countries to collect fitting innovation metrics"* (Cornell University, INSEAD, and the World Intellectual Property Organization [WIPO], 2019).

According to the GII 2019 rankings, the study countries faired as provided in Table 40 below. Kenya is ranked 2nd in sub-Saharan Africa with a score of 31.13% behind South Africa. Botswana is ranked 4th, Ghana 11^{th,} Nigeria 14th, Malawi 17th and Zambia 22nd. This index considered the general innovations across different sectors that are being generated by 129 countries worldwide including innovations that can be categorized as Eco-innovations. The rankings are based on and reflect the investments in the infrastructure for innovation and the outputs. The accumulated points based on the scores achieved by each country on different indicators. Kenya ranks tops among the study countries and therefore has higher potential in leading in Eco-innovation enhancement since it has an existing infrastructure to anchor on. The other study countries need to have a strong political will and conviction to emulate South Africa and Kenya if we consider the leaders in sub-Saharan Africa.

Table 40: Global Innovation Index Ranking for the study countries

	Country	GII Score (%)	GII Ranking	Income classification	Income classification Ranking	Sub-Saharan Africa Ranking
1.	Kenya	31.13	77	Lower middle	10	2
2.	Botswana	27.43	93	Upper middle	29	4
3.	Ghana	25.27	106	Lower middle	19	11
4.	Nigeria	23.93	114	Lower middle	22	14
5.	Malawi	23.00	118	Low income	10	17
6.	Zambia	20.36	124	Lower middle	26	22

Source: Cornell University, INSEAD, and WIPO, 2019

The Innovation Input Sub-Index is comprised of five pillars that capture elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication (Annex II). In terms of Innovation Input Sub-Index rankings, the countries faired as provided in Table 41 below. Botswana ranks tops among the study countries. It has put some innovation infrastructure and substantial human capital and research which form a good basis for anchoring Eco-innovation. However, these need to be supported by solid strategies, plans and policies in order to at least optimally achieve results commensurate with the investments made.

Table 41: Innovation Input Sub-Index Ranking for the study countries

	Country	Innovation Input Score (%)	Innovation Input Ranking	Income classification	Income classification Ranking	Sub-Saharan Africa Ranking
1.	Kenya	38.07	89	Lower middle	12	5
2.	Botswana	40.86	80	Upper middle	23	4
3.	Ghana	32.80	109	Lower middle	20	9
4.	Nigeria	31.46	116	Lower middle	24	15
5.	Malawi	30.76	119	Low income	10	17
6.	Zambia	27.97	126	Lower middle	26	24

Source: Cornell University, INSEAD, and WIPO, 2019

The Innovation Output Sub-Index provides information about outputs that are the result of innovative activities within economies. There are two output pillars: (1) Knowledge and technology outputs and (2) Creative outputs (Annex II). In terms of Innovation Output Sub-Index ranking, the countries faired as provided in Table 42 below. Kenya tops in this category in sub-Saharan Africa. Kenya has an inherently creative population but to tap and bring out this creativity requires sufficient investment and stimulus programmes. The government, development partners and private sector have supported programmes such as talent competitions, sponsored training and

incubation of innovative entrepreneurs and start-ups. This has led to increased outputs of innovations, technologies and knowledge. Ghana also fairs very well in this category. It has a good infrastructure that supports research in various sectors which are strongly supported by the government and the private sector.

Table 42: Innovation Output Sub-Index rankings for the study countries

	Country	Innovation Output Score (%)	Innovation Output Ranking	Income classification	Income classification Ranking	Sub-Saharan Africa Ranking
1.	Kenya	24.20	64	Lower middle	8	1
2.	Botswana	13.99	117	Upper middle	33	19
3.	Ghana	17.74	97	Lower middle	17	8
4.	Nigeria	16.40	105	Lower middle	19	11
5.	Malawi	15.25	112	Low income	9	16
6.	Zambia	12.74	121	Lower middle	25	20

Source: Cornell University, INSEAD, and WIPO, 2019

Eco-innovation principles have emphasized the innovations that focus on the whole lifecycle of processes, competitiveness, environmental sensitivity, efficiency and effectiveness and for the well-being of humanity with minimal waste. The GII considers Institutions (political, regulatory and business environment), Human Capital and Research (Education and R&D), Infrastructure (ICTs, general infrastructure, ecological sustainability), Market Sophistication (Credit, Investment, Trade, Competition & market scale), Business Sophistication (Knowledge workers, Innovation linkages and Knowledge absorption) and on the output side, Knowledge and Technology Outputs (Knowledge creation, Knowledge impact and Knowledge diffusion), Creative Outputs (Intangible assets, Creative goods & services and Online creativity). These are in line with what Eco-innovation would consider although aspects of overall human benefit are not captured in the indicators.

The GII has, therefore, provided a means for providing measured progress regarding developments in innovation systems, related infrastructure, investment in R&D in relation to GDP as well as other human indicators. The sub-pillar on ecological sustainability (on the inputs) includes three indicators GDP per unit of energy use (a measure of efficiency in the use of energy), the Environmental Performance Index of Yale and Columbia Universities, and the number of certificates of conformity with standard ISO 14001 on environmental management systems issued. This puts the index as a good measure for Eco-innovation.

4. COMPARATIVE ANALYSIS OF ECO-INNOVATION IN THE STUDY COUNTRIES

4.1 Overview

This chapter analyses the different models of innovation systems that support Eco-innovation in the study countries. The aspects that work well, those that do not work, and why will be discussed to help countries to adopt the most effective approaches for quicker implementation of Eco-innovation. The study countries compared very well in many aspects of Eco-innovation principles and practices. It is worth noting that there is no 'one size fits all' approach to enhancing Eco-innovation. This is because no two countries are alike. Countries have different political, economic, social, cultural and environmental conditions. They also differ in national priorities, needs, capabilities, resources and stages of development. This means that each country will have unique Eco-innovation needs and will have to develop its approaches to stimulating Eco-innovation efforts. Secondly, the countries themselves are not homogeneous. They differ significantly and can be as much diversity within a country as that observed between them. Thirdly, each stage of the Eco-innovation process may require different mixes of actors, institutions, networks and financing models. Fourthly, the Eco-innovation approaches required for different sectors can vary, so would require different technologies within a sector. In summary, different Eco-innovation approaches will be needed to address different problems in different contexts. However, it is also important to note that some approaches may work across different countries depending on similarities between them in terms of needs, capabilities and political, economic, social, cultural and environmental conditions.

4.2 Comparison of Eco-innovation related Policy Landscape

Some substantial progress in terms of policy landscape has been made in the study countries. This progress is discussed in the following subsections that include but not limited to putting in place policies, plans and strategies that consider Eco-innovation principles across key sectors in the study countries. This analysis is based on the views of the majority of the key informants interviewed and secondary literature.

The study findings revealed that there are no explicit Eco-innovation policies that primarily advocate for Eco-innovation in all the study countries. There are, however, some aspects of Eco-innovation captured in different sectoral policies, plans and strategies. Among these, environmental, agricultural, climate change policies, Trade & Industry as well as Transport & Communication sectors. In Zambia, for instance, no explicit policies are supporting and putting Eco-innovation into practice. However, there are many policies geared towards improving STI in the country. The Eco-innovation related aspects are entrenched in the green economy and very strong environmental policies. Furthermore, there has been a major constraint to the effective development and application of science and technology in the study countries. For example, lack of a clear Science, Technology and Innovation Policy to provide guidelines for the development and application of STI into a green economy in Zambia. There exists a myriad of policies in Zambia which support the agriculture, environment and energy sectors but within these policies, there was no explicit support of Eco-innovation. Zambia, therefore, has numerous good policies targeting the STI, environment, energy, forestry and agriculture with a very strong emphasis on sustainability. This is also the case in the other study countries.

There exist a number of legal regulations and guiding principles on Eco-innovation in the study countries aligned to the different sectors that oversee and regulate the different aspects of Eco-

innovation. In Kenya for instance, the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 was the first Kenyan Environmental Framework law that was designed to regulate environmental issues. The promulgation of the Constitution of Kenya 2010 and other Policies like Climate Change Policy marked an important chapter in Kenya's environmental policy development acting as an umbrella for innovation under the Environmental Act. Chapter V of the 2010 constitution is entirely dedicated to land and environment providing for key principles in Eco-innovation. The provision states that "*Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.*" However, many sectoral policies and laws are not harmonized with each other and with the Constitution. The sectoral policies, laws and regulations targeting the environment, forest, water, trade and industry which have great significance have not been integrated and interlinked into one ecosystem coordinated regulations thus, the innovations developed only fall into the different independent sectors. For example, there are innovations for industries that may be embraced, that have negative impacts on the environment yet are beneficial to the industrial sector. The Green Economy Strategy and Implementation Plan (GESIP) 2016-2030 focuses on the binding challenges that Kenya faces in the attainment of Vision 2030. It aims to ensure a low carbon, resource-efficient, equitable and inclusive socio-economic transformation. Kenya led the banning of plastic bags in 2017 as proposed by EAC in the year 2011. The plastics bags were replaced with bags made of biodegradable materials in line with Eco-innovation. This was a gazette notice No. 2356 of the Kenya Environmental Management and Co-ordination Act. The banning of plastic bags prompted the innovation and development of other environmentally friendly alternative products for similar use. According to an internal assessment by Kenya's National Environment Management Authority (NEMA), 80% of the population has stopped using plastic carrier bags since the ban was adopted. KAM claims that the plastic bag ban led to a loss of jobs, investment and markets as some manufacturers closed their businesses and others relocated to other countries but it has also brought new business opportunities and diversification of operations to produce fabric-based bags, non-woven bags, pulp paper-based bags amongst others which is consistent with Eco-innovation.

In Nigeria, the aspect of Eco-innovation has been captured in the National Renewable Energy and Energy Efficiency Policy of 2015 where its implementation will ultimately increase the efficiency, security and reliability of energy supply, thus improving the people's living standards and also reduce the negative environmental impacts such as air, water and soil pollution. Furthermore, compared to other RECIRCULATE project implementing countries, the Nigerian Bio-fuel Policy and Incentives of 2007 established a thriving fuel ethanol industry by utilizing agricultural products as a means of improving the quality of automotive fossil-based fuels. This strategy aimed at reducing Ozone pollution, reduction in particulate emissions and replacement of toxic octane enhancers in gasoline. Botswana has lately begun to incorporate the Eco-innovation related aspects in its energy sector like the Botswana Biomass Energy Strategy of 2009. This policy has ensured the production of biomass energy which has been supplied and used in a socially, economically and environmentally sustainable manner. In Ghana, Eco-innovation, green economy, green growth, Clean Development Mechanisms and related concepts have in recent years been considered in Ghana's development plans, policies and strategies. Botswana needs a national research agenda that could provide a clear and deliberate direction to the various stakeholders on priority areas which could guide on the technologies that may impact the lives of Batswana. The different institutions are each pulling in their direction without a common point of reference which

has led to duplication of efforts (same type of research being carried out without collaborative effort) and a disconnect between other stakeholders, for instance, research institutions and the private sector. Also, there are Policies designed to create harmony in the pursuit of knowledge about the environment through R&D. They include the National Science and Technology Policy (1986) and National Science, Technology and Innovation Policy (2012). The revised Science and Technology Policy emphasizes on "innovation", which has become a global tool for fast-tracking sustainable development.

Many policies in Ghana support Eco-innovation aspects starting with the 1992 Constitution that provides a broad policy basis for the protection of the environment in Ghana. Specifically, the basis of Environmental Policy in Ghana is grounded in Article 36(9) of the 1992 Constitution. The Direct Principles of State Policy places a responsibility on every Ghanaian and the government to protect and safeguard the environment for posterity. It explicitly requires the government to take relevant steps aimed at the protection and defence of the national environment for future generations. Various institutions are mandated to implement this. The Environmental Protection Agency, (EPA) an agency of MESTI, established by EPA Act 490 (1994) oversees the implementations of National Environmental Policy under the areas of environmental innovations. The Agency has the authority to act on environmental protection in Ghana and ensures compliance of businesses with Ghanaian Environment & Social laws in embracing the aspect of an eco-friendly environment. The EPA issues fines and penalties for businesses that are not in compliance with embracing the environmental friendliness Acts. The Minerals and Mining Act in Ghana requires that, among other things, a holder of a mining license, before commencing mining activities, must obtain the necessary environmental permits that are meant to ensure the protection of the environment and other key principles of Eco-innovation.

Further, Ghana has remained a signatory to many international conventions and treaties that address Climate Change, the Environment and its Sustainability. In 2005 a body was set up at the then Ministry of Environment, Science and Technology (MEST) called the Ghana Environmental Convention Coordinating Authority (GECCA) to coordinate the ratification (in some cases) and implementation of these international conventions and treaties on the environment. Some of these Conventions and Treaties include Cartagena Protocol on Biosafety, Stockholm Convention on Persistent Organic Pollutants, Kyoto Protocol to the United Nations Conventions on Climate Change, Paris Agreement on Climate Change etc. Compliance with these international treaties and conventions has placed Ghana in a better position in embracing and implementing Eco-innovation.

Currently, the Ministry of Environment, Science, Technology, and Innovation in collaboration with other key Ministries, Agencies and the private sector in Ghana is implementing a number of policy initiatives aimed at achieving the "Ghana Beyond Aid Agenda." Ghana is currently participating in the Transformative Innovation Policy (TIP) initiative through the innovative policy for waste management which is a major challenge in Ghana. Various governments have developed several policies and strategies aimed at addressing waste disposal and management in the country. The President, in his quest to solve the waste management issue in the country, established a Ministry of Sanitation and has tasked various related ministries such as MESTI, the Ministry of Local Government and other state agencies to work together to develop policies and programmes that will aggressively tackle the menace of waste in the country. In light of this, several policies have been developed and some being developed for waste management. Some of these policies

include the Environment Policy, the Plastic waste policy, the E-waste Policy and law, and the Sanitation Policy, to name a few.

A myriad of eco-friendly legal regulations and guiding principles exist in Botswana that gear towards promoting the principles of Eco-innovation under different sectors. Environmental Impact Assessment Act (Act No. 6 of 2005) (Cap. 65:07) and Atmospheric Pollution (Prevention) Act (Chapter 65:03) all of which tend to bend every human activity towards alignment of the eco-friendly practices. However, all the legal regulations and guiding principles do not refer to the Eco-innovation concept directly.

In Malawi, the sparing perennial rainfall has necessitated the growth of the green innovation Centre which is aimed at churning out innovations that minimize the deteriorations of the environment, therefore, protecting the more important agricultural sector. The Environment Management Act, 2017 (No. 19 of 2017) provides for actions that prevent harmful environmental practice and embrace all activities geared towards protecting the environment.

In Zambia, Eco-innovation is a new concept that is not found in Zambia's policy documents. However, there are legal regulations and guiding principles that support Eco-innovation such as the Energy Regulation (Amendment) Act (2003) and the National Science and Technology Act which tend to bend all the innovation to be aligned to Eco-innovation practices. Zambia's Vision 2030 (2006-2030) focuses on three priority sectors: Economic growth and wealth creation; Social investment and human development; and creating an enabling environment for sustainable social-economic development. These are the key principles of Eco-innovation. However, the presence of these strategies and elaborate plans has not fully translated to the development of Eco-innovation in the countries or ensured environmental sustainability. This is a good beginning and but a lot needs to be done to implement these as contained on paper as well as mainstream Eco-innovation. Investment in these strategies and plans have not been sufficient enough to achieve what is on paper. The implementation of these is at different stages in the different study countries and gauging progress made by these countries is beyond the scope of this study.

Most of the study countries have consciously or unconsciously incorporated most of the principles of Eco-innovation in their national strategies, sectoral strategies, Visions or in the development plans or sectoral strategic plans. In Kenya, the National Biodiversity Strategy and Action Plan and Environment Action Plan embrace most of the Eco-innovation aspects. Ghana's blueprint for sustainable socio-economic development is the Vision 2020 document put together by the National Development Planning Commission (NDPC) is embedded with the Eco-innovation principles supporting the environmental sectors. In Nigeria, the five-year Science, Technology and Innovation Plan of Action 2019-2024 incorporates the ideas that bide well with Eco-innovation. In Botswana, Guidelines are being drafted on renewable energy tariffs paving way for incorporation into the national grid. The 2017 renewable energy strategy is being used to guide the drafting of the guidelines.

4.3 Comparison of Eco-innovation Institutional Landscape

All the study countries have almost the same institutional infrastructure that serves to support the implementation of various policies. The role of these institutions is in most instances clearly defined by the various policies as has been analysed in Chapter 3 of this report. The organization

of these institutions largely depend on the structures of government and how the different sectors are organized. In Kenya, the energy sector is regulated by the Ministry of Energy and Petroleum and Energy and Petroleum Regulatory Authority (EPRA). They are mandated to take such action as is necessary to enforce the requirements in a petroleum agreement or any regulations and to protect the environment, the health and safety of workers and the public; Work with the relevant statutory authorities to formulate, enforce and review environmental, health, safety and quality standards for the Energy sector among others. This places significant responsibility on the institutions albeit for the energy sector to ensure that environmental standards, safety and sustainability are attained. They ensure that demand is met with reliable, cost-effective and high-quality energy services in an environmentally friendly manner.

The National Environment Management Authority (NEMA) in Kenya ensures the implementation of all environment-related policies, laws and regulations. The majority of the university and colleges in Kenya conduct research and training on climate change adaptation and mitigation, as well as implanting new programs on climate change adaptation and mitigation. This has led to the utilization of the skills learnt by the students and researchers to innovate in the sector, thereby, advancing the principles of Eco-innovation. The media team has also played a critical in Kenya by creating awareness of ecologically friendly innovations and new technologies for climate change adaptation and mitigation.

In Nigeria, the Renewable Energy Division and the Bio-fuels Energy Commission supports Eco-innovation in the country by the creation of the biofuels industry. The Centres for Energy Research in Nigeria conduct research activities for alternative and more efficient sources of energy for both domestic and industrial use, for instance, the research on using solar energy for domestic cooking. The State Environmental Protection Agencies (SEPA) works in collaboration with other relevant ministries such as the ministry of agriculture to protect the environment and its biodiversity. It is also mandated to create awareness on environmental issues through the Public awareness Master Plans. All these institutional arrangements are justifying Nigeria's embrace of Eco-innovation.

4.3.1 Presence of a National Authority or Commission in charge of Innovation

The National Authorities and Commissions play a critical role in the coordination and development of the STI sector in the countries where they are present. Irrespective of a country's challenges and circumstances, successful Eco-innovation interventions depend on a sound national system of innovation. A national system of innovation is a combination of actors, institutions (both organizations and policies/laws) and networks that interplay to undertake and drive the innovation process in a national setting. A sound national system of innovation provides the conditions for innovation to flourish without attempting to pick winners. Building a strong system of innovation requires the strengthening of each of these three elements (TEC, 2015). There is a need to develop a strong education system (developing human capacity), institutions (developing organizations that design, implement and monitor effective policies, regulations and standards, thus creating a strong enabling environment), and networks (facilitating collaboration and interaction among the different actors). Strong political leadership that can incentivize and help to coordinate the technological innovation process and guide the national system of innovation towards priority areas (in our context, those related to a low-carbon economy and Eco-innovation) is paramount.

While these steps may be clear, the reality is that many countries face coordination, resource and capacity challenges to building strong innovation systems. Short-term priorities can make it difficult to keep measures in place that are crucial for developing the system but take many years to yield results. A country may therefore wish to focus its limited resources on a particular development challenge. In Kenya, the National Commission for Science, Technology and Innovation (NACOSTI) and the Kenya National Innovation Agency (KENIA) have clear roles and responsibilities in the Kenyan NIS. The Nigerian Federal Ministry of Science and Technology is a statutory organ of the government, with the responsibility to direct activities in the Science and Technology Sector, including liaison with international and national organizations. It also coordinates with the National Research and Innovation Council (NRIC) to implement STI policies.

In Malawi, there is the National Commission for Science and Technology (NCST). The NCST is a government central organization whose mandate is to promote, support, co-ordinate and regulate research, the development and application of science and technology matters in Malawi. In Zambia, the National Science and Technology Council (NSTC) was established to enhance Zambia's capacity for scientific research and technological development in order to create wealth and improve the quality of life in Zambia. These elaborate the responsibility of each of the actors in the NIS and provides clear linkages, unlike the Botswana system where various institutions have their separate roles with no central coordination institution. It is left for the ministry through the Department of Research, Science and Technology, under the government to provide leadership in science and technology in Botswana which sometimes can be overwhelming with the many other roles the designated ministry plays. This works to the disadvantage of the promotion of Eco-innovation.

A central coordinating institution serves to consolidate data on the various innovations and technologies that have been churned out as well as ongoing activities for the various sector. A major constraint in implementing policies that promote Eco-innovation is identifying manufacturing sub-sectors that have the most potential for improved resource efficiency and pollutant reduction because of the vacuum of economic, environmental and resource use data. In Ghana, the Ministry of Environment, Science, Technology and Innovation (MESTI) was established to provide leadership and guidance in policy formulation regarding the environment, science and technology. There is no central institution dedicated to coordinating STI and research. The role has been divided amongst various research institutions such as CSIR.

Malawi does not have a national research fund which all institutions can access based on the quality and the impact of the projects they seek to undertake. It has only established a challenge fund that is only periodically available for environmental-related research and innovation. The absence of a national research fund limits the extent to which research may be carried out as it needs financial support for it to be intensive and impactful. Kenya for example has established a national research fund but has not generated the impact yet due to interference from politicians and some government officials. However, politics play a major role and influence decision making at ministerial levels. Long bureaucratic processes inhibit progress in policy implementation which is sometimes caused by the change in leadership in ministries.

4.3.2 Participation of various stakeholders in promoting Eco-innovation

There were many research organizations or universities that are supporting the development and testing innovations including Eco-innovations in the study countries. These research organizations and universities are part of the NIS and are either private or public or quasi-government organizations. Others are part of NGOs supported by development partners/donors and are sector-specific. For example, in Kenya in the Agricultural sector, there is the government-supported KARLO, several universities are focusing on Agricultural studies such as Egerton University and the Jomo Kenyatta University of Agricultural Technology. There are also international research organizations with their headquarters in Kenya. Some of the research international NGOs include the International Livestock Research Institute (ILRI), World Agroforestry Center, International Center of Insect Physiology and Ecology (ICIPE), International Center for Tropical Agriculture (CIAT), African Technology Policy Studies Network (ATPS) among others. Private companies in Kenya, such as Safaricom have tremendously supported the innovation in Kenya both in the environment and agriculture sector. Private organizations like Sun Culture and Chandaria have promoted innovation within the line of industry, environment and agriculture.

In Ghana, several sectoral bodies promote Eco-innovation in different sectors such as the Agriculture sector, Forestry sector, Mining sector, Water sector, Environment and Natural Resources sectors. The Private sector and NGOs are also involved in research activities that have come up with innovations that can be classified as Eco-innovations in all the study countries. Such companies include Unilever, Puma, BNP Paribas Group have been supporting research and innovation in agriculture in Ghana.

In Malawi, the sectoral bodies that promote Eco-innovation were primarily from the agriculture sector, environment and Natural resources, Science, Technology and Innovation and Industry and trade sectors. In Nigeria, the Federal Institute of Industrial Research (FIIRO), Forestry Research Institute of Nigeria (FRIN) and National Institute for Freshwater Fisheries Research (NIFFR) are very important in supporting innovations. In Zambia, the Zambia Agriculture Research Institute (ZARI) and the University of Zambia among others are known for coming up with innovations.

In Botswana, the private sector plays a significant role in the development of the economy but it seems to be excluded in a number of matters, for instance, institutions like BITRI and BIUST in Botswana were established to support the private sector, with knowledge, however more often these seem to be providing the technologies to the communities directly, instead of providing the intellectual support to business owners who will, in turn, bring the technologies to the people.

Tremendous work has been done in the study countries in terms of initiating programmes that are aimed at coming up with solutions to the many challenges facing the countries. These have also been targeting different sectors. However, the shortage of skilled personnel poses as one of the constraints to Eco-innovation uptake. In some of the study countries such as Kenya and Ghana, there are competitions organized to encourage entrepreneurs to showcase their innovations and are judged by a panel of experts on their viability, environmental sustainability as well as their potential for economic development. In Ghana, Kosmos Innovation Centre (KIC) was started to advance locally-led, market-driven solutions to some of the country's key challenges. It is an effort to channel young people's innovative entrepreneurialism into the country's agricultural sector. Each year, KIC takes approximately 120 aspiring entrepreneurs through the KIC AgriTech

Challenge, a series of market research tours, capacity-building programs, team-building exercises, and pitch competitions, culminating in seed funding and incubation support to a handful of high-potential start-ups that emerge from the program. In Kenya, Kenya Climate Innovation Center (KCIC)[20] offers incubation, capacity building and financing options to new, small and medium business ventures and Kenyan entrepreneurs and new ventures that are developing innovative solutions in energy, water and agribusiness to address climate change. These initiatives help accelerate the development, deployment and transfer of locally relevant technologies and innovations. Countries must develop similar or even better initiatives that would accelerate the development and deployment of Eco-innovations.

Kenya, Ghana, Malawi and Zambia are members of the Science Granting Councils Initiative (SGCI)[21] that aims to strengthen the capacities of 15 science granting councils in Sub-Saharan Africa in order to support research and evidence-based policies that will contribute to economic and social development. The SGCI contributes to strengthening the ability of science granting councils to Manage research, design and monitor research programmes based on the use of robust STI indicators, support knowledge exchange with the private sector, and strengthen partnerships between Science Granting Councils and other science system actors. This to a large extent has made the countries strengthen their innovation systems thereby putting them in a better position to support Eco-innovation.

In all the RECIRCULATE participating countries, from the foregone discussions in the individual countries, there was rarely an incidence where all the stakeholders were participating in the Eco-innovation programmes as most of the countries did not have clear policies, plans or platforms to engage in Eco-innovation. Not all the stakeholders were found participating in the innovation programmes, but different countries had different stakeholders participating in their NIS setup. In Kenya and Nigeria, media centres have been creating awareness of environment-related innovations as compared to other countries. This is very critical as educating the public and other stakeholders on this concept will go a long way in influencing them to push for more reforms in their respective countries.

[20] https://www.kenyacic.org/
[21] https://sgciafrica.org/en-za/home

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Eco-innovation in Africa is fairly a new term but the concept has always been there only that it has always been implemented partially through other related concepts such as green economy, green growth, clean development mechanisms, circular economy among others. This concept covers any innovation resulting in significant progress towards the goal of sustainable development, by reducing the impacts of production modes on the environment, enhancing nature's resilience to environmental pressures, or achieving more efficient and responsible use of natural resources. The demand for Eco-innovations is increasing across the globe as a way of mitigating against the prevalent economic and environmental challenges. This follows a realization that without ecological stability, there is no economic sustainability. This has been witnessed through increased resource-saving and more efficient innovations and technologies deployed in different regions for sustainable and increased productivity across various sectors of the economy. However, many countries especially in Africa are not conversant with the term Eco-innovation though they embrace various aspects of it. It is also evident that many African countries do not have explicit Eco-innovation policies and strategies to guide and support Eco-innovation processes and activities. This is no different in the six (6) RECIRCULATE project implementing countries: Botswana, Ghana, Kenya, Malawi, Nigeria and Zambia. The RECIRCULATE project works to deliver innovative solutions to pressing problems with water use and safety. The project adopted a model that incorporates business communities, researchers/Universities in developing solutions to various challenges. It was deemed necessary to commission a study to understand the policy and institutional landscape of Eco-innovation in the RECIRCULATE implementing countries.

The findings reveal that the study countries do not have a stand-alone Eco-innovation policy but Eco-innovation principles are embedded in the numerous sectoral policies, strategies and development plans. The constitutions of most of the countries have emphasized some aspects of Eco-innovation. The Agriculture, Environment & Natural Resources (Water, Forestry & Mining included), STI, Energy, Trade & Industry and Transport are among the key sectors cutting across the study countries that have Eco-innovation related policies, principles, practices and strategies. On the institutional front, all the study countries have put in place structures that are aimed at generating technologies and innovations that are aimed at addressing their respective national challenges. It is under these structures that Eco-innovation can be anchored since already they recognize that STI is critical in steering development by generating innovative solutions that will enhance productivity as well as ensure environmental sustainability. All the study countries are signatories to key statutes and have ratified various international conventions that are aimed at reducing emissions to curb climate change, conservation of biodiversity and enhancing environmental sustainability. These agreements have very strong Eco-innovation principles entailed in them. The findings also reveal weak linkages between public research organizations and academia-industry cooperation. Alongside the government actors, NGOs and private sector actors working with development partners, play a key role in the innovation systems in the countries. They are involved in research and development activities that have generated technologies that have transformed and continue to transform different sectors.

The policy and institutional landscape in the study countries have had different impacts as far as Eco-innovation is concerned. There is no ‘one size fits all’ approach for enhancing Eco-innovation

in these countries. This is because no two countries are alike. The countries have different political, economic, social, cultural and environmental conditions. They also differ in national priorities, needs, capabilities, resources and stages of development. This means that each country will have unique Eco-innovation needs and will have to develop its approaches to stimulating Eco-innovation efforts. However, some approaches can work across the different varying countries in exceptional circumstances. It is these lessons that the countries can learn from each other and apply in their contexts. The initiatives implemented in the respective countries have had varying levels of success as well as failure based on the approaches used. The lessons gained during the implementation of these initiatives and projects will help ensure success in future projects aimed at Eco-innovation development. The Global Innovation Index 2019 ranked the study countries differently based on the various indicators that range from the political environment, education, infrastructure and business sophistication. Kenya was ranked 2nd after South Africa in sub-Saharan Africa, while Botswana was ranked 4th, Ghana 11th, Nigeria 14th, Malawi 17th and Zambia 22nd. Although the ranking criteria did not target Eco-innovation indicators *per se*, most of the indicators are consistent with what Eco-innovation, therefore, can be used to gauge how a country is progressing towards developing systems that support Eco-innovation. However, it would be interesting to see if the criteria used in GII ranking can increasingly measure more aspects of Eco-innovation as much as possible in the future ranking, to provide a clearer picture of Eco-innovation in Africa.

5.2 Recommendations

There is no doubt that there are policies and institutional structures that can fully steer Eco-innovation in the study countries. The STI implementation infrastructure provides a good base to anchor Eco-innovation and tweaks the focus in the generation and use of STI to accommodate Eco-innovation. However, there are issues that the study countries need to address to fully embrace Eco-innovation. These are elaborated in the recommendations below:

i) Increase investment in Eco-innovation research and development

This can be done by increasing allocation for R&D and/or identifying new collaborative arrangements for technology research, development and demonstration, including financing and public-private partnerships. It is also important to support Eco-innovation R&D using relevant policy instruments. Policy instruments are interventions of governments intended to achieve outcomes that conform to the objectives of public policy e.g., tax relief, public expenditures, penalties, economic incentives etc. These policy instruments should incentivize more investment and development of new Eco-innovation projects, by both public and private stakeholders. There need to be real commitments to mobilizing financial resources from both public and private sources as well as increasing international cooperation efforts for STI and Eco-innovation by extension.

ii) Develop structures that provide incentives for Eco-innovation and discourage environmentally unfriendly processes

Policies should be re-oriented to support Eco-innovation activities across the different sectors in the study countries. They should consider a holistic view of Eco-innovation, not only focussing on the resource utilization but the entire life cycle process, including re-use and recycling. Governments have a range of environmental policy tools at their disposal: regulatory (or "command-and-control") instruments, market-based instruments (such as taxes and tradable

permits), negotiated agreements, subsidies, environmental management systems and information campaigns. Although no one instrument can be considered best to address every environmental challenge, there has been a growing movement towards environmentally related taxation. Incentives such as tax relief should be given to outstanding eco-innovators and entrepreneurs to motivate them. In Nigeria for example tax holidays are available for pioneer products and companies granted licenses for such products. The holiday period covers an initial period of three years, renewable for an additional two years. A new company going into mining of solid materials is exempted from tax for the first three years of operation. Environmental standards should also be set upon which production processes can be assessed to ensure adherence to Eco-innovation principles. There should be strong enforcement mechanisms to ensure that there is no flouting of measures put in place to support these principles.

iii) Enact stringent policies and laws that support Eco-innovation

Since the study revealed that no country has a stand-alone policy on Eco-innovation among the study countries, every sector of the economy indeed has principles geared towards promoting Eco-innovation, knowingly or unknowingly. Unsupportive legislation and government licensing make people shy away from business opportunities and innovations. New markets for eco-friendly innovations and technologies should be established locally. For instance, banning plastic bags in Kenya has opened up business opportunities for eco-friendly carrier bags. This will ensure that all innovators can market their products, thus creating a good business opportunity for them. In doing so, they should ensure that the government is always on board to make the entire process easier.

iv) Improve policy alignment around Eco-innovation and strengthen coordination

Effective inter-ministerial coordination and harmonization of policies is key to entrenching Eco-innovation. The development of innovation systems requires coordinated policy intervention both within government line ministries and between key STI institutions. In Ghana, almost all the sectors have plans and strategies that crisscross one another. For example, the forestry commission's plantation plan which started from 2016-2040 aims to develop the country's forest reserves and plants population but with the 'Planting for food and job project', farmers are trying to acquire more lands to cultivate their crops which are not available. If these policies are not aligned, they could be counterproductive.

v) Continental and Regional Economic Communities should take lead in encouraging countries to embrace Eco-innovation

Political will is a major enabler of Eco-innovation. Individual countries must have buy-in. Increasing the political goodwill by nations to develop Eco-innovation policy at the continental, regional and national levels is very critical for its development. These policies should be developed to align with the NIS so as to ensure seamless implementation. Eco-innovation can easily be sold to the political leadership of the countries through the continental bodies such as the AU or the respective RECs. Voicing Eco-innovation through these highly influential bodies will instil responsibility into the individual countries and their leaderships. Such international/regional institutions should put in place economic consequences to discourage member countries from contravening established policies. For instance, suspension from the AU/Regional Eco-innovation institution after flouting a particular policy (ies).

vi) Mainstream Eco-innovation into the curricula of educational institutions in Africa

In order to ensure the sustainability of Eco-innovation, academic curricula at all levels of education should be aligned with Eco-innovation. This is one way of ensuring the community is educated on Eco-innovation, thus bridging the knowledge gap. This will help to orient learners to Eco-innovation careers for the future sustainability of Eco-innovation. In addition to academic curricula review, it is also important for governments to be cognizance of gender inequalities and the plight of women folk, youth and people living with disabilities in terms of academic support towards Eco-innovation. World Economic Forum (2020) noted that science and gender equality are very important in helping the world attain sustainable development goals. For this reason, more policies and efforts need to put in place to help inspire women and girls to study and work in the Science, Technology, Engineering and Mathematics (STEM)[22] fields as this is aimed at achieving sustainability in Eco-innovation. In Zambia, Copperbelt University has developed programmes in Bioenergy technologies and renewable energy. These programmes are running at Masters and PhD levels.

vii) Strengthen national institutions with the capacity to adequately implement Eco-innovation policies and programs

For every country to clearly understand the domains of Eco-innovation, each country may need to establish a national institution mandated to handle matters of innovation and by extension promote Eco-innovation. Such a body needs to be responsible for national and international coordination of Eco-innovation matters through relevant government ministries. It should be able to organise Eco-innovation annual conferences where participants from different parts of the world showcase their skills. This would require increased capacity building on Eco-innovation to improve the capacity of staff in these institutions to be able to effectively handle Eco-innovation related issues. Some of the aspects that would require their intervention are curricula reform, Eco-innovation sustainability by encouraging Eco-innovation in learning institutions at all levels through sponsoring co-curricular activities like Science Congress in schools. Outstanding participants should not only just be awarded certificates of participation but also nurtured, assisted to identify Eco-innovation related careers and sponsored to pursue the career to higher levels of education with the principal aim of promoting and sustaining Eco-innovation. This can be achieved by partnering with the Ministry of Education or STI through the government. A good example of an initiative in Africa is the SGCI that has been supporting countries by building their capacity for research and evidence-based policies development that will contribute to economic and social development.

viii) Inclusive participation of all stakeholders in Eco-innovation development (research, policy and practice)

The national commissions and the respective responsible ministries need to mobilize stakeholders to develop structures for formal and informal participation in matters relating to Eco-innovation. It has been shown in the study findings that there are many players in STI from NGOs, the private sector (Businesses) that have contributed immensely to the development of the sector. However, there are still weak linkages between and amongst these actors who can potentially be very productive in promoting Eco-innovation and its principles. Industrial and STI policy must specify mechanisms to enhance system linkages between the various actors, and ensure successful

[22] https://www.weforum.org/agenda/2020/02/stem-gender-inequality-researchers-bias

implementation of these mechanisms. For instance, mechanisms that incentivize private sector engagement (co-publication, co-patenting and personnel mobility) with local stakeholders (industry experts and local researchers). In addition, governments should consider increasing liaisons with the private sector to identify the needs of private enterprises in order to encourage their participation in the NIS. The SGCI has also been very instrumental in supporting these in Africa by supporting knowledge exchange with the private sector and strengthening partnerships between Science Granting Councils and other science system actors including development partners and the private sector.

ix) Invest in the necessary infrastructure, equipment and human resource capacity to support Eco-innovation

The right infrastructure and laboratory equipment is vital for eco-innovators to efficiently and effectively carry out research and training. All the study countries do not currently have sufficient institutions that provide training in Eco-innovation and limited research is conducted due to lack of facilities. There is need for the respective governments to tap into available opportunities nationally and internationally to develop these. For instance, the Climate Technology Centre and Network[23] plays a key role in providing climate technology and policy assistance. To respond to developing country requests for technical assistance on technological innovation issues, the network can draw on the expertise of over 300 network members. Indeed, it pledged to support developing countries to develop national innovation centres. UNFCCC technology needs assessments can also play a role by helping developing countries to identify and prioritize their Eco-innovation needs and priorities. Outcomes of the assessment process, such as technology action plans, may facilitate strategic planning and implementation of innovation processes.

x) Awareness creation and advocacy in support of Eco-innovation development in government policies and programs

The concept of Eco-innovation needs to be promoted across different stakeholders. This requires strong media campaigns, exhibitions, competitions, the establishment of technological parks and incubation centres. More information needs to be availed out there to inform the masses on this concept and how it can be applied to improve their lives. It has been demonstrated that awareness creation leads to higher demands for accountability from the informed public and therefore pushing for more reforms that compel the relevant stakeholders to act. More informed policymakers and actors will always push for the inclusion of Eco-innovation related aspects in plans, strategies and even policies that they are working to formulate.

xi) Liaise with international standards organizations to develop Robust Indicators for measuring Eco-innovation

Eco-innovation progress needs to be measured just like how innovation is assessed in the GII. There is need for the international community or the UN or the continental bodies such as the AU to lead in the development of indicators that can be used to measure progress towards implementation of Eco-innovation, especially for Africa. This will provide a basis to which countries can track how they are progressing and quickly put measures in place to rectify areas where they are scoring lowly. The GII sets good precedence in this and can as well be strengthened to capture more data that relates to Eco-innovation.

[23] https://www.ctc-n.org/

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ANNEXES

Annex I: List of participants in the surveys – Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs)

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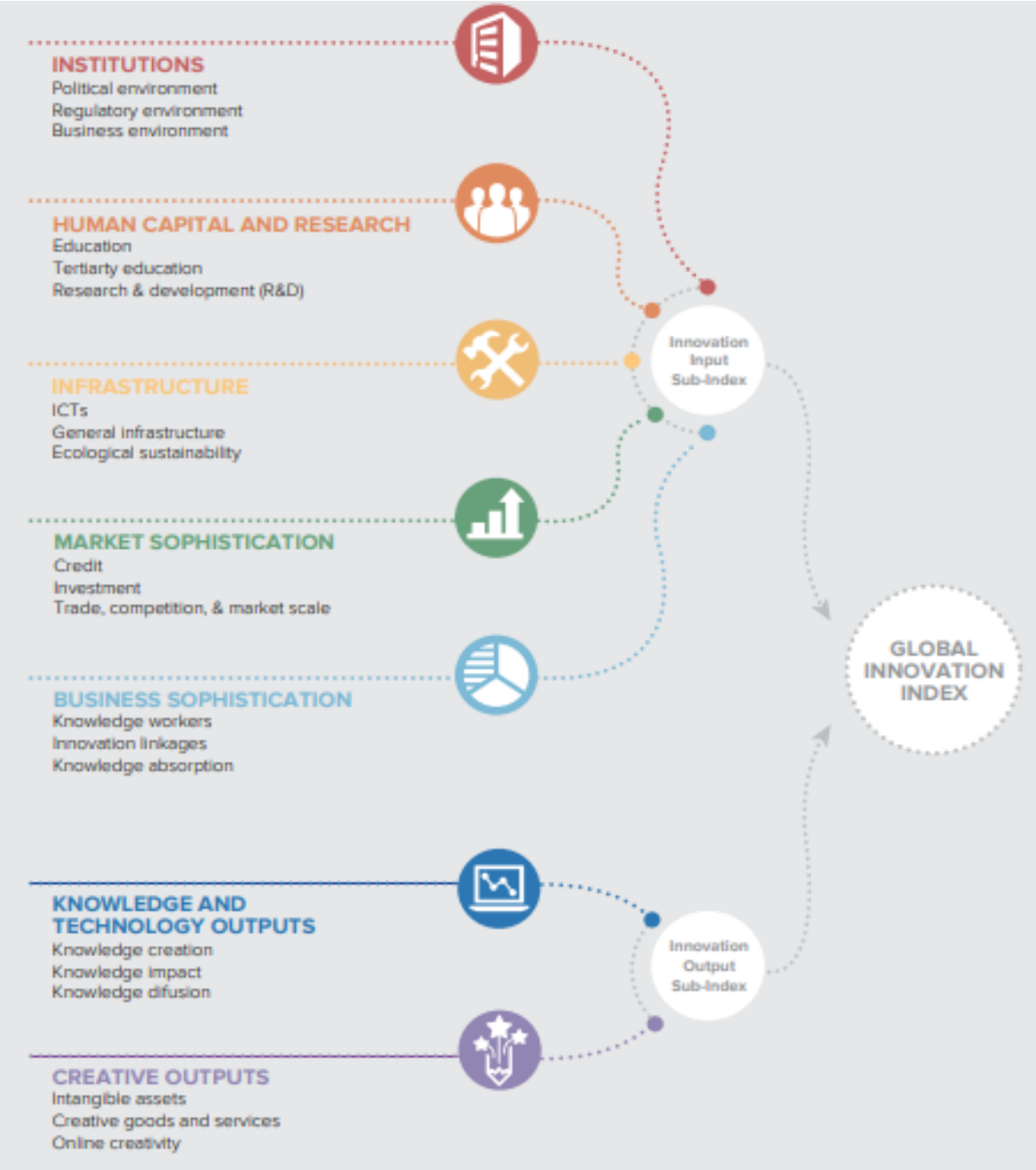
Annex II: Framework of the Global Innovation Index 2019



Annex III: Data Collection tools

REVIEW OF THE POLICY AND INSTITUTIONAL LANDSCAPE FOR ECO-INNOVATION IN AFRICA

Key Informant Interview (KII) Questionnaire

This Key Informant Interview (KII) questionnaire was prepared by the African Technology Policy Studies Network (ATPS) to review and analyze the Policy and Institutional landscape for Eco-innovation in the six RECIRCULATE countries including Kenya, Nigeria, Botswana, Ghana, Malawi and Zambia. According to Reid and Miedzinski (2008), Eco-innovation is defined as "the creation of novel and competitively priced goods, processes, systems, services, and procedures designed to satisfy human needs and provide a better quality of life for everyone with a whole-life-cycle minimal use of natural resources (materials including energy and surface area) per unit output, and a minimal release of toxic substances". This study aims to review and analyze existing policies related to Eco-innovation development in the six RECIRCULATE countries with a view to understand what works (successes), what does not work (failures) and why (reasons for successes or failures). In addition, institutions responsible for Eco-innovation will be mapped to understand the actors, roles, linkages and contexts that will promote Eco-innovation sustainability in the target areas.

To achieve the stated objectives, information will be sought from policymakers (governments), research organizations, private sector actors, civil society and the media fraternity. The information obtained will be used to inform policy changes that support the development and sustainability of Eco-innovation in Africa. The questionnaire will take about 30 minutes of the respondent's time. All the data and entries of the respondent will be anonymized in the analysis and project publications. Respondents will however be included in the distribution lists for final project outputs and knowledge products.

1. Introduction

Date

Respondent specific details

1.1. Name of respondent (optional):
1.2. Phone number:
1.3. Email address:
1.4. Name of organization you work in:
1.5. Designation:
1.6. Number of years worked in the organization:
1.7. In which sector(s) does your organization identify with or work within:

a. Agriculture ☐
b. Environment and natural resources ☐
c. Water resources ☐
d. Science, Technology and Innovation ☐
e. Industry and trade ☐
f. Energy ☐
g. Forestry ☐

h. Other (please specify):

1.8. Category of organization/respondent

a. Policymaker (government) ☐
b. Public/private research organization ☐
c. Academic institution ☐
d. Non-Governmental Organization/Civil Society Organization ☐
e. Private Organization ☐
f. Media organization/representative ☐
g. General public ☐
h. Any other (please specify):

2. Broad conceptualization of Eco-innovation concept

2.1 Are you familiar with the concept of Eco-innovation? Yes ☐ No☐

2.1.1 If yes (***in Q 2.1 above***), what is your understanding of the Concept?

2.2 Which forms of Eco-innovation are you aware of?

2.3 How does your organization support Eco-innovation?

3. Country specific Eco-innovation perspectives (*This section aims to understand the forms of innovations that exist in the target countries, sectors involved and the drivers/barriers of Eco-innovation development*)

3.1 Which forms of Eco-innovation exist in your country? Please list and explain

3.2 Which of the following sectors in your country/economy support Eco-innovation development and how? (***Please fill the table below and add more rows as convenient***)

Sector(s) of economy	**Does it support Eco-innovation development?**		**If yes, how does it support Eco-innovation development?**
	Yes	**No**	
Agriculture	☐	☐	
Environment and Natural resources	☐	☐	
Water resources	☐	☐	
Science, Technology and Innovation	☐	☐	
Industry and trade	☐	☐	
Energy	☐	☐	
Forestry	☐	☐	
Other (specify):	☐	☐	

3.3 Are you aware of any drivers/ factors that enable Eco-innovation development in your country? Yes ☐ No ☐

3.3.1 If yes, please list and explain them

3.4 Are you aware of any barriers/factors that constrain Eco-innovation development in your country? Yes ☐ No ☐
3.4.1 If yes, please list and explain them

4. Sector-Specific Eco-innovation related national Policies and Frameworks (*this section aims to review and analyze all national policy frameworks related to Eco-innovation in the six RECIRCULATE countries*)
4.1. Please list all Eco-innovation related policies in your country, specifying their years of enactment and the sectors they apply.

4.2 Are there any specific statements/sections in the above-mentioned policies that explicitly support Eco-innovation development? Yes ☐ No ☐
4.2.1 If yes (***in Q 4.2 above***), please mention that specific statement/section of the policy

4.3For each of the existing policies listed in 4.1 above, please mention at least one major impact it has made in favour of or against Eco-innovation development in your country

4.4 What can be attributed to the positive or negative impact stated above?

4.5 Do you think that a new national policy on Eco-innovation is necessary or required now? Yes ☐ No ☐
4.6 If yes or no, kindly state your reasons

4.7 What policy will you advocate for in favour of Eco-innovation development in your country?

4.8 Mention five (5) strategies that you can propose for the successful and sustainable implementation of the policy mentioned above in your country

4.9 If you do not prefer a standalone policy on Eco-innovation in your country, which amendment to an existing policy or framework will you prefer/propose? **(*State the existing policy and the amendment(s) preferred)***

5. Continental and Regional enablers and/or constrainers of Eco-innovation (*this section aims to identify all factors driving and/or constraining Eco-innovation development and sustainability in the regions and Africa)*
5.1 Are you aware of any drivers or enablers of Eco-innovation in your region/Africa? Yes ☐ No☐
5.1.1 If yes, please list and explain them

5.2 Are you aware of any barriers/constrainers of Eco-innovation in your region/Africa? Yes ☐ No ☐
5.2.1 If Yes, kindly list and explain them

6. Continental and Regional Eco-innovation related policy frameworks *(this section aims to review and analyze all Eco-innovation relevant policies in the regions and Africa)*
6.1 Please list all policies in your region/Africa that are relevant to Eco-innovation, including the years of their enactment and the sectors they apply.

6.2 Are there any specific statements/sections in the above-mentioned policies that explicitly support Eco-innovation development? Yes ☐ No ☐
6.2.1 If yes (***in Q 6.2 above***), please mention that specific statement/section of the policy

6.3 For each of the existing policies listed in 6.1 above, please mention at least one major impact it has made in favour of or against Eco-innovation development in your region/Africa

6.4 What can be attributed to the positive or negative impact stated above?

6.5 Do you think that a new regional/continental policy on Eco-innovation is necessary or required now? Yes ☐ No ☐
6.6 If yes or no, kindly state your reasons

6.7 What policy will you advocate in favour of Eco-innovation development in your region/Africa?

6.8 Mention five (5) strategies that you can propose for the successful and sustainable implementation of the policy mentioned above in your region/Africa

6.9 If you do not prefer a standalone policy on Eco-innovation in your region/Africa, which amendment to an existing policy or framework will you prefer/propose? (***State the existing policy and the amendment(s) preferred)***

7. Sector-Specific Eco-innovation relevant national Institutions and actors (*This section aims to map all institutions and actors who support Eco-innovation development and sustainability in the target countries)*
7.1 In each of the sectors listed below, please list all institutions and actors who support Eco-innovation development and sustainability in your country

Name of institution	**Actors under each institution**	**Roles played by actor in support of Eco-innovation development**	**Existing linkages between actors and institutions**	**Achievements by actor/institution**	**Challenges faced by actor/institution**
1. Agriculture sector					
2. Environment and Natural resources sector					
3. Science, Technology and Innovation sector					
4. Industry and trade sector					
5. Energy sector					
6. **Other sector (please specify):**					

7.2 In your opinion, are there challenges faced by these institutions and actors in promoting Eco-innovation development in your country? Yes ☐ No ☐

7.2.1 If yes in question 7.2 above, please explain them

7.3 In your opinion, are there any achievements made so far by these institutions and actors in promoting Eco-innovation development in your country? Yes ☐ No ☐
7.3.1. If yes, please list and explain them

7.4 For sustainability of Eco-innovation development in your country, what institutional amendments/changes can you propose?

7.5 Is there a central body in your country that is in charge of driving and coordinating Eco-innovation across sectors? If Yes, please name it and state its roles. If No, is there a need for such a body and why? Please Explain.

REVIEW OF THE POLICY AND INSTITUTIONAL LANDSCAPE FOR ECO-INNOVATION IN AFRICA

Focus Group Discussion (FGD) Guide

This Focus Group Discussion (FGD) guide was prepared by the African Technology Policy Studies Network (ATPS) to review and analyze the Policy and Institutional landscape for Eco-innovation in the six RECIRCULATE countries including Kenya, Nigeria, Botswana, Ghana, Malawi and Zambia. According to Reid and Miedzinski (2008), Eco-innovation is defined as "the creation of novel and competitively priced goods, processes, systems, services, and procedures designed to satisfy human needs and provide a better quality of life for everyone with a whole-life-cycle minimal use of natural resources (materials including energy and surface area) per unit output, and a minimal release of toxic substances". From the African context, Eco-innovation is a type of innovation that is good to the environment and society. Some countries refer to it as clean technologies, green innovation, green growth or green economy. It can also be defined as an innovation that increases resource use efficiency, increasing productivity and minimizing costs with no harmful effects on the natural environment. This study aims to review and analyze existing policies related to Eco-innovation development in the six RECIRCULATE countries with a view to understand what works (successes), what does not work (failures) and why (reasons for successes or failures). In addition, institutions and actors responsible for Eco-innovation will be mapped to understand the actors, roles, linkages and contexts that will promote Eco-innovation sustainability in the target areas.

To achieve the stated objectives, information will be sought from policymakers (governments), research organizations, private sector actors, civil society and the media fraternity. The information obtained will be used to inform policy changes that support the development and sustainability of Eco-innovation in Africa.

Discussion Guiding Questions

1. Country-specific Eco-innovation perspectives (*This section aims to understand the forms of innovations that exist in the target countries, sectors involved, the drivers and/or barriers of Eco-innovation development)*

1.1 How can you define Eco-innovation from your country's perspective? Kindly come up with a generally acceptable definition of the concept from your perspective.

1.2 Please list and discuss the forms of Eco-innovation that exist in your country

1.3 Which sectors of the economy support Eco-innovation development in your country and how?

1.4 Please list and discuss the drivers/ factors that enable Eco-innovation development in your country

1.5 Please list and discuss the barriers/factors that constrain Eco-innovation development in your country

2. Sector-Specific Eco-innovation related national Policies, Strategies and Frameworks (*This section aims to review and analyze all national policy frameworks related to Eco-innovation in the six RECIRCULATE countries)*

2.1. Please list and discuss all Eco-innovation related policies in your country, specifying their years of enactment, the sectors they apply and how they support or oppose Eco-innovation development

2.2 For each of the existing policies listed in 2.1 above, please (a) mention at least one major impact it has had in favour of or against Eco-innovation development in your country and (b) what this impact can be attributed to

2.3 What policy changes[24] would you advocate in favour of Eco-innovation development in your country? (This can include enacting a stand-alone Eco-innovation policy or integrating aspects of Eco-innovation into existing policies).

2.4 Mention five (5) strategies/amendments that you can propose for the successful and sustainable implementation of the policy changes mentioned above in your country.

3. Continental and Regional enablers and/or constrainers of Eco-innovation (*This section aims to identify all factors driving and/or constraining Eco-innovation development and sustainability in the regions and Africa)*

3.1 Please list and discuss the drivers/ factors that enable Eco-innovation development at the African Union level (continental level)

3.2 Please list and discuss the drivers/ factors that enable Eco-innovation development in your region (i.e. EAC, ECOWAS, SADC)

3.3 Please list and discuss the barriers/factors that constrain Eco-innovation development in Africa

3.4 Please list and discuss the barriers/factors that constrain Eco-innovation development in your region (EAC, ECOWAS, SADC)

3.5 Please list and discuss the (a) enablers and (b) barriers of Eco-innovation development that are specific to your country.

4. Regional Eco-innovation related policy frameworks (*This section aims to review and analyze all Eco-innovation relevant policies in the regions, i.e. EAC, ECOWAS, SADC*)

4.1 Please list and discuss all Eco-innovation related policies in your region (e.g. EAC, ECOWAS, SADC as the case may be), specifying their years of enactment, the sectors they apply and how they support or oppose Eco-innovation

4.2 For each of the existing policies listed in 4.1 above, please mention at least one major impact it has had in favour of or against Eco-innovation development in your region and what this impact can be attributed to

4.3 What policy changes would you advocate in favour of Eco-innovation development in your region?

4.4 Mention five (5) strategies/amendments that you can propose for the successful and sustainable implementation of the policy changes mentioned above (question 4.3) in your region

5. Continental Eco-innovation related policy frameworks (This section aims to review and analyze all Eco-innovation relevant policies in Africa)

5.1 Please list and discuss all Eco-innovation related policies in Africa, specifying their years of enactment, the sectors they apply and how they support or oppose Eco-innovation in the continent5.2 For each of the existing policies listed in 5.1 above, please mention at least one major impact it has had in favour of or against Eco-innovation development in Africa and what it can be attributed to

5.3 What policy changes would you advocate in favour of Eco-innovation development in Africa?

[24] Policy changes can either mean amending the already existing policies to incorporate aspects of Eco-Innovation development or formulating new Eco-Innovation policies

5.4 Mention five (5) strategies/amendments that you can propose for the successful and sustainable implementation of the policy changes mentioned above in Africa

6. Sector-Specific Eco-innovation relevant national Institutions and actors (This section aims to map all institutions and actors who support Eco-innovation development and sustainability in the target countries)

6.1 List and discuss all the institutions and actors (ministries, departments, agencies, entities and organizations, etc. both public and private) that support the implementation and development of Eco-innovation in your country across all sectors, stating the sectors they work in and their roles in support of Eco-innovation in the country.

6.2 Discuss the linkages that exist between and among the institutions and actors listed above

6.3 Discuss the achievements and the challenges faced by the above-mentioned institutions and actors in executing their mandate/role in support of Eco-innovation development in your country.

6.4 For sustainability of Eco-innovation development in your country, what institutional amendments/ changes do you propose?

6.5 Is there a central body in your country that is in charge of driving and coordinating innovation related issues across sectors? If Yes, please name it and state its roles. If No, is there a need for such a body and why? Please discuss

7. Eco-innovation relevant regional Institutions and actors (This section aims to map all institutions and actors who support Eco-innovation development and sustainability in the regions (EAC, SADC, ECOWAS))

7.1 List and discuss all the institutions and actors (ministries, departments, agencies, entities and organizations, etc. both public and private) that support the implementation and development of Eco-innovation in your region across all sectors, stating the sectors they work in and their roles in support of Eco-innovation in the country.

7.2 Discuss the linkages that exist between and among the institutions and actors listed above

7.3 Discuss the achievements and the challenges faced by the above-mentioned institutions and actors in executing their mandate/role in support of Eco-innovation development in your region.

7.4 For sustainability of Eco-innovation development in your region, what institutional amendments/changes do you propose?

8. Eco-innovation relevant Institutions and actors in Africa (This section aims to map all institutions and actors who support Eco-innovation development and sustainability in the continent)

8.1 List and discuss all the institutions and actors (ministries, departments, agencies, entities and organizations, etc. both public and private) that support the implementation and development of Eco-innovation at the African level across all sectors, stating the sectors they work in and their roles in support of Eco-innovation in the country.

8.2 Discuss the linkages that exist between and among the institutions and actors listed above

8.3 Discuss the achievements and the challenges faced by the above-mentioned institutions and actors in executing their mandate/role in support of Eco-innovation development in Africa.

8.4 For sustainability of Eco-innovation development in Africa, what institutional amendments/changes do you propose?