



Institutional Landscape for Eco-innovation Development in Africa

African Technology Policy Studies Network
(ATPS) Technopolicy Brief No. 60

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Institutional Landscape for Eco- innovation Development in Africa

Case studies from Botswana, Ghana, Kenya, Malawi, Nigeria and Zambia

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African Technology Policy Studies Network (ATPS)



The African Technology Policy Studies Network (ATPS) is a transdisciplinary network of researchers, policymakers, private sector actors and the civil society promoting the generation, dissemination, use and mastery of Science, Technology and Innovations (STI) for African development, environmental sustainability and global inclusion. In collaboration with like-minded institutions, ATPS provides platforms for regional and international research and knowledge sharing in order to build Africa's capabilities in STI policy research, policymaking and implementation for sustainable development.



Published by the African Technology Policy Studies Network (ATPS)

P. O. Box 10081, 00100- GPO, Nairobi, Kenya

© 2021

ISBN: 978-9966-124-80-7

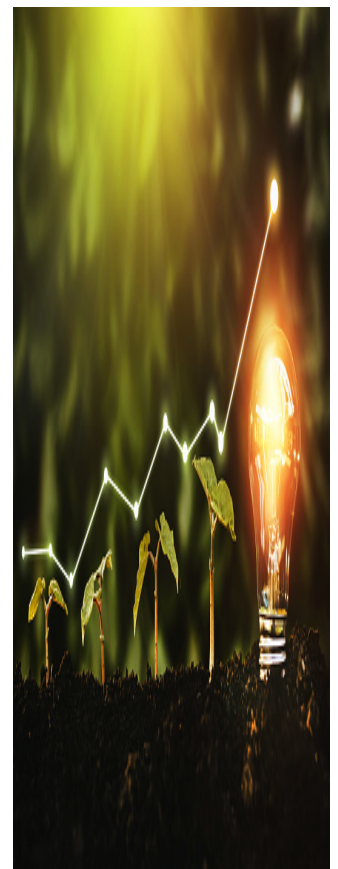


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About the RECIRCULATE project

The Lancaster University, UK through its Centre for Global Eco-innovation (GCE) aims to support high quality research partnerships to establish systems necessary to move from research to solutions and support the long-term transition from a resource-based to a knowledge-based economy. Lancaster University is well known for translating high quality research into real world impacts. The RECIRCULATE project, Lancaster University is funded by the Research Councils UK through the Global Challenges Research Fund (GCRF) which has the stated aim of “Growing Research Capability to Meet the Challenges Faced by Developing Countries”. In that sense, RECIRCULATE is quite different from many traditional research projects. While there is a clear research focus on a circular water economy there is also a broader underpinning aim to support new partnership-based approaches to enable African researchers and research institutions to grow transformational impact through (i) working with, in and for their communities and (ii) developing robust, durable and equitable partnerships with UK researchers. That aim certainly applies to water research and is relevant to all disciplines and sectors if research is to underpin sustainable and equitable growth. The project is being implemented through research and trainings delivered in the United Kingdom and Africa. The project partners include: University of Benin, Nigeria; Council for Scientific and Industrial Research, Ghana and Lancaster University, Ghana Campus; Botswana International University of Science and Technology; National Commission for Science and Technology Malawi; Copperbelt University, Zambia; and the African Technology Policy Studies Network (ATPS). ATPS was commissioned to conduct a policy and institutional landscape review on Eco-innovation targeting the RECIRCULATE project implementing countries: Botswana, Ghana, Kenya, Malawi, Nigeria and Zambia. It is from this study that this policy brief has been developed.

About the African Technology Policy Studies Network (ATPS)

The African Technology Policy Studies Network (ATPS)¹ is a trans-disciplinary network of researchers, policymakers, private sector actors and civil society actors that promote the generation, dissemination, use and mastery of Science, Technology and Innovations (STI) for African development, environmental sustainability and global inclusion. ATPS has over 5,000 network members and 3,000 stakeholders in over 51 countries in 5 continents with institutional partnerships worldwide. We implement our programs through members in national chapters established in 30 countries (27 in Africa and 3 Diaspora chapters in Australia, the United States of America and the United Kingdom). In collaboration with like-minded institutions, ATPS provides platforms for regional and international research and knowledge sharing in order to build Africa's capabilities in STI policy research, policymaking and implementation for sustainable development.

¹ <https://atpsnet.org/>

Acknowledgement

This policy brief was produced by the African Technology Policy Studies Network (ATPS) with support from Lancaster University, UK. The ATPS takes this opportunity to thank all the ATPS National Chapter Coordinators in the study countries, the lead researchers and facilitators for their efforts in contributing to the success of the research especially amid the COVID-19 pandemic. We also thank the respondents in the study countries for their inputs. Special thanks to the RECIRCULATE project community for their inputs and support throughout the study period. The ATPS also thanks the RECIRCULATE managers for their technical inputs and support throughout the study period.

Key Messages

- Whereas Eco-innovation is relatively a new concept in the study countries, there is a good understanding of the concept by stakeholders who align the concept with other similar concepts such as green growth, green innovation, green energy, green cities/smart cities/sustainable cities, green technologies, smart agriculture, ecological innovation, clean technologies, circular economy, and eco-friendly innovations.
- Institutional collaborations between and amongst relevant actors including policymakers, researchers, private sector actors and the civil society actors are required to institutionalise, promote and sustain Eco-innovation development in Africa. Collaboration and cooperation lead to interactive learning, and the flow of research and technology into industry for successful commercialisation and diffusion of eco-innovative solutions.
- Eco-innovation practice needs to be established within a strong institutional framework comprising of both policy and organizational structures.

1. Introduction

In many developing countries, there are pockets and islands of innovativeness, or individual entrepreneurs with an innovative spirit, in otherwise static and traditional economies. Much attention has recently been paid to innovation as a way for industry and policymakers to achieve more radical, systemic improvements incorporate environmental practices and performance. Many companies have started to use Eco-innovation or similar terms to describe their contributions to sustainable development. A few governments are also promoting the concept as a way to meet sustainable development targets while keeping industry and the economy competitive. However, while the promotion of Eco-innovation by industry and government involves the pursuit of both economic and environmental sustainability, the scope and application of the concept tend to differ. 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, because the protection of the biosphere will influence current and future competitiveness for organizations (Stock et. al., 2018).

The promotion of Eco-innovation has been mainly focusing on environmental technologies, but there is a tendency to broaden the scope of the concept. This is because of the growing concerns about the state of the natural environment due to the negative impacts of greenhouse gas emissions, inefficiency in natural resource and waste management as well as the devastating impacts of pollution among many others. Given the urgency of the environmental challenges, emerging and developing countries need to build their capacities for researching, inventing, adapting or adopting new technologies to counter these challenges. They also need to establish the necessary demand to help such innovations develop and prosper.

Eco-innovation provides a competitive advantage to businesses by creating win-win opportunities for economic development, positive impact on society and reducing harm to the environment. Eco-innovation is an integral part of the successful transformation towards a green economy. There is a need to develop incremental and ground-breaking innovations in terms of products, processes, business models and utilisation systems while existing technologies must be rapidly scaled up and widely disseminated. However, Eco-innovations suffer from a two-fold market failure: a) entrepreneurs and companies cannot be sure,

whether and to what extent they will recover their STI-related expenditure by securing a larger market share and/or higher profit margin because newly created knowledge tends to leak out to competitors rather quickly, a process that cannot ultimately be contained by using patents or copyrights (Mansfield, 1985) and b) non-internalised, negative environmental externalities of conventional modes of production, such as greenhouse gas emissions, water pollution, unsustainable logging and solid waste disposal. Significant government intervention is, therefore, needed to overcome these barriers. At the same time, policymakers must be aware of the trade-offs, costs and risks typically involved in these kinds of industrial and innovation policy.

Eco-innovation is more important now than ever on the public policy agenda. It is a major driver for green growth and contributes to environmental performance and economic development (OECD, 2011a). Building on the Organisation for Economic Co-operation and Development (OECD) Innovation Strategy, it argues that Eco-innovation is not merely about technological developments, non-technical innovations matter as well. It acknowledges that policies do not operate in a vacuum and that they must take account of the institutional contexts that influence the development and diffusion of Eco-innovation.

It is against this background that African Technology Policy Studies Network (ATPS) conducted a review study to understand the institutional frameworks for Eco-innovation in six (6) African countries: Botswana, Ghana, Kenya, Malawi, Nigeria and Zambia. This study was supported by the RECIRCULATE project that is led by Lancaster University, UK.

1.1 Rationale for Eco-innovation Institutional Framework in Africa

The OECD stresses that no strong and widely shared definition of Eco-innovation has as yet been developed. There have been a variety of definitions across countries and sometimes across authorities in a single country (OECD, 2011b). The European Commission, defining Eco-innovations “*as all forms of innovation that reduce environmental impacts and/or optimise the use of resources throughout the lifecycle of related activities.*” Reid and Miedzinski (2008), defined it 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 context of Eco-innovation may determine how successfully the innovation is received and diffused, but finding

opportunities for innovation first requires an understanding of where it comes from and which direction the innovation should take [increasing quality of products, improving the ecological environment, diversifying products, etc.] (Nisida, 2011). Eco-innovation needs to be established within a strong institutional framework (including both policy and organizational structures). Without strong institutional structures, there would be serious challenges with respect to the roles and responsibilities of relevant actors in the innovation system which then may lead to conflicts and the implementation of Eco-innovation practices in silos.

Most of the challenges of Eco-innovation development in African countries are a result of the economic structures of the countries; their institutional policies and weak infrastructures; their weak financial and capital markets; and their failure to establish effective trade protocols. The weak infrastructure and institutional policies of many of the countries are partly responsible for poor intra-African trade. Also, the numerous roadblocks and checkpoints on main roads in Africa contribute immensely to increasing the delays in the delivery of goods and in raising transport costs. The setting up of a robust institutional structure would cut down the bureaucracies and increase efficiency and coordination among the relevant entities thereby encouraging Eco-innovation.

The African business environment provides a wide range of opportunities to foster the development and implementation of eco-innovative business practices, which can contribute substantially to the improvement of social welfare. Eco-innovation can also provide local communities with the possibility of technological leapfrogging, significantly reducing the use of scarce natural resources and resulting in decreased production costs for businesses, as well as easier access to basic services for the local population. Collaboration could also unfold in platforms to identify technologies to match needs with existing solutions, establish testing centres and business incubation hubs for networking, explore and generate ideas, and assess and avoid related risks.

1.2 The National Innovation System and its implication for Eco-innovation

An innovation system can be defined as a collection of organizations, institutions, government and people that interact in the production and diffusion of new economically useful knowledge (James et. al., 2019). Innovations are not only developed but also produced, diffused, and used. They also change during these processes. The multiphase interactions amongst academia, government and industries allow the exchange of knowledge, Research and Development (R&D) and innovations. Successful implementation

of Eco-innovation policies requires action by various social actors – government, business, investors, consumers, researchers, educators and civil society– since Eco-innovation has effects that go beyond businesses, extending to the broader society and the natural environment (United Nations Environment Programme [UNEP], 2017). Given these requirements, governments should convene relevant stakeholders for consultations and joint action to share the responsibility for transitioning into more sustainable consumption and production through Eco-innovation practices and to distribute its benefits equally (*Ibid*).

One important issue for Eco-innovation policies is how to bring together actors from the various sub-systems of the innovation system. To unpack these linkages, three different settings should be distinguished. *Horizontal linkages* include linkages within the same stakeholder group. The main challenge here is to promote cooperation between companies with complementary assets, including knowledge. *Vertical linkages (1)* involve linkages between actors in the publicly funded research system and the private business sector, whereas, *Vertical linkages (2)* are those between the providers of innovative solutions and the (potential) users, be it commercial clients, public entities (schools, public housing or water authorities) etc. Companies/organizations are usually extremely reluctant to establish horizontal linkages with their peers. This is especially true for organizations/companies whose competitive advantage lies in their specific knowledge-based advantage rather than, for instance, their built production capacities and related economies of scale. These companies fear losing their competitive edge if their rivals gain access to formerly secret proprietary knowledge. In this respect, managers and decision-makers will regard networking between companies more as a risk than as a potential benefit. The same thinking also prevents companies from establishing closer vertical linkages with publicly funded research organisations, as even this can result in strategic knowledge leaking out to competitors (Mansfield, 1985).

Other factors hampering collaboration between private business and public research include the different motivating factors (patents versus publications), time considerations (first on the market, versus scientifically well-founded results) and even language issues (practically oriented, comprehensible language as opposed to the jargon of a scientific community). The complexity of government interventions to promote Eco-innovations that are intended to have a real impact on the environmental sustainability of economic growth and the aggregated social consumption of goods and services can now be appreciated. An additional governance challenge is the fact that special weight

must be given to the dissemination phase. Eco-innovations often need to be deployed on a wide scale and as fast as possible, for reasons that are separate from the economic process (UNEP 2017). All these different roles and interactions need to be knitted well in the National Innovation System (NIS) for Eco-innovation to thrive with minimal problems and challenges.

Eco-innovation relies on an interactive process between different partners in the value chain and within a system. Availability of interfaces for open and creative exchange and collaboration among stakeholders is essential to provide knowledge as input to Eco-innovation and to mobilise the right competencies required for systemic change. Policy measures for Eco-innovation should be formulated to encourage interaction and align the technical competencies of businesses and knowledge institutions. The active involvement of stakeholders is important to facilitate social acceptance of changes and amplify the scale for Eco-innovation through productive links across value chain actors and different sectors.

International organizations and development partners are also very critical in the NIS to enhance Eco-innovation. For instance, the African Development Bank (AfDB) is playing an increasing role in promoting sustainable initiatives. Given its mandate in the area of climate change, the Bank is taking the lead in promoting environmental and climate-friendly infrastructure, notably hydro and new and renewable energy and transport. Beyond its support for infrastructure development, the Bank is expected to mobilise its lending windows to support the financing of economically productive infrastructure and services linked to the development of the region's natural resources potential (AfDB, 2010).

2. Methodology

This study was conducted in six (6) African countries namely: Botswana, Ghana, Kenya, Malawi, Nigeria and Zambia. Both primary and secondary data collection methods were used. 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 purposively identified 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) KIIs 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 institutional frameworks, the existing institutional linkages as well as the proposed recommendations to ensure the sustainability of Eco-innovation in those countries, the progress made, challenges, opportunities and benefits in promoting Eco-innovation development.

3. Major Findings

3.1 Supporting National Policies, Strategies, and Regulations

All the study countries have put in place structures for generating technologies and innovations that are aimed at solving their respective national problems. It is under these structures that Eco-innovation can be anchored. STI policy is particularly supportive of the innovation process, from idea generation to entry and diffusion into the market. STI policy has traditionally supported early-stage R&D for technological breakthroughs, and diffusion and outreach. These policies receive priority attention in countries with economic growth strategies based on advanced technology. Over the last few years, there has been an important shift in refocusing STI policies towards sustainability issues to accelerate the transition to green economy strategies. In Botswana, the *Strategy for Economic Diversification and Sustainable Growth of 2008* focussed on addressing the primary challenge facing their economy, which was 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 proposed the establishment of Botswana Innovation Hub, which is intended to foster the development of a high technology sector. Customized to *the Vision 2030*, Kenya formulated STI Policy framework, consisting of the *STI policy and strategy (2008)* and enacted *the Science, Technology and Innovation Act in 2013*, (STI Act, 2013) that emphasize the need for a coordinated functional innovation system in which universities (and public research institutes) play a leading role in knowledge and technology generation through research and development (Bolo et. al., 2015). These would provide a fertile foundation for Eco-innovation to thrive in Kenya. Malawi developed the *National Science and Technology Policy (NSTP) of 2002* which set principles through which the country

disciplined its development by utilizing its human resources. This policy put in place strategies that will enable the country to achieve a technology-based development.

In Nigeria, *the National Science, Technology and Innovation Policy of 2012* was designed in line with the objectives and pillars of the *Nigerian Vision 20:2020*, thus serving as a link between economic planning and science and technology. This means that the policy provides an opportunity to design pathways/strategies to instil Eco-innovation ideologies in national plans as well as in sectoral plans. In Zambia, the *National Science and Technology Policy of 2020* was developed 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. On the other hand, the *Science and Technology Act No.26 of 1997* established the National Science and Technology Council (NSTC) with the mission to enhance Zambia's capacity for scientific research and technological development.

In Ghana, *the National Science, Technology and Innovation Policy of 2017* aims to provide a framework for stimulating innovation in the economy and society. The policy places emphasis 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.

3.2 National Innovation System and the role of National Innovation Institutions in Eco-innovation

Irrespective of a country's challenge and circumstance, 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 three elements namely: (a) a strong education system (developing human capacity), (b) institutions (developing organizations that design, implement and monitor effective policies, regulations, and standards, thus creating a strong enabling environment), and (c) networks (facilitating collaboration and interaction among the different actors) (TEC, 2015). 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. The organization of national coordinating institutions largely depend on the structures of government and how the different sectors are organized.

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. Visionary management and managerial concern are considered two of the most important factors in the development of Eco-innovations, along with key resources and capabilities such as qualified personnel, networking, and absorptive capacity, and green organizational identity.

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. 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.

The enactment of the STI Act of 2013 created three agencies namely: The National Commission for Science Technology and Innovation (NACOSTI), the Kenya National Innovation Agency (KENIA), and the National Research Fund (NRF) to streamline and enhance the effectiveness and efficiency of the National Innovation System (NIS) through clearly defined functions for each agency. KENIA is charged with managing the NSI to enhance linkages within the system among the government, academia, and industry while the National Research Fund is charged with funding national research both in terms of supporting the performance of R&D in all sectors of the economy as well as providing infrastructure support to Universities and research institutions to upgrade their technological capabilities and enhance the performance of R&D.

In Nigeria, 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.

3.3 Ministries, Departments, and Agencies (MDAs)

The MDAs are often established by the Executive to promote sustainable development by deepening and strengthening market-driven R&D for sound Science, Technology and Innovation through intensive awareness creation, collaboration and partnership. The various study countries have established Departments and Agencies under the ministry responsible for STI in the respective countries which have been given various mandates. Some of the agencies have been created by Policies or Executive orders. Many of the study countries face coordination, resource and capacity challenge to building strong innovation systems. From experiences in the past, it has been noted that 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 rather than investing in systems that will only yield benefits in the long term.

It is important to note that the countries that have a dedicated ministry for STI such as Ghana where the Ministry of Environment, Science, Technology and Innovation created under Executive Instrument (E.I.) 1 Civil Service (Ministries) Instrument, 2013 plays a lead role have been seen to perform well in the STI

sector. Incidentally, Ghana has an advantage for Eco-innovation implementation as the ministry also deals with environmental issues. In Malawi, there is the Ministry of Education, Science and Technology and Botswana has the Ministry of Tertiary Education, Research Science and Technology but both of them lack the innovation component which is very crucial for purposes of anchoring Eco-innovation and any other important innovation that supports environmental conservation and sustainability. Kenya ironically does not have an STI ministry but STI related issues are handled under the Ministry of Education. The ministry also coordinates the departments and agencies established to handle STI. In the case of Zambia, the Department of Science and Technology in the Ministry of Education, Science, Vocational Training and Early Education (MESVTEE) is the principal institution implementing STI in Zambia. There is need to ensure that MDAs and Private sector entities in the development of structures and systems that would assist mainstream environmental sustainability are supported technically as well as financially.

3.4 Public Awareness and Political Goodwill

Public support for green innovation/Eco-innovation targets specific priority sectors such as water, energy and transport, and takes the form of direct R&D, grants to SMEs, facilitation of risk capital for green technology development and diffusion, innovation awards through prize and other recognition schemes, and support of demonstration projects in a late stage of development. These policy and programmatic actions are complemented by regulation and economic instruments such as subsidies to increase the adoption of greener technologies. Political will is also important as the political leadership has powers to support the development of institutions for Research, universities and also funding various types of research. It is this will that will also enable policy review to include Eco-innovation in the development of national policies as well as in the sectoral policies.

An important shift in recent years has seen an increase in public awareness that has led to focus on demand-side innovation policies such as public procurement, standard operating procedures, and consumer policy to increase demand for green technological solutions. However, more needs to be done to increase awareness of Eco-innovation in the study countries. The political will to support STI is very important as it allows other important factors such as policies, strategies and plans to be developed and most importantly allocates funds to implement the plans. It is also important to note that the countries that have a dedicated ministry for STI such as Ghana where the Ministry of Environment, Science, Technology and Innovation plays a lead role have been seen to perform

well in the STI sector. The Executive that supports STI will likely develop their governance structure with a strong recognition of STI for instance the Big 4 agenda and Vision 2030 in Kenya which have STI as the key driver for their achievement. Political will is also important as the political leadership has powers to support the development of institutions for Research, universities and most importantly providing funding for research. It is this will that will also enable reviews of existing national/sectoral policies, strategies and plans to include Eco-innovation.

4. Conclusion

Science Technology and Innovation are the key drivers of sustainable development in Africa. Experience from successful sub-Saharan countries shows that STI is critical at all stages of the development process, therefore, technological change/innovation is the key driver of economic development. For this to be successful, countries must develop global institutional arrangements that increase international cooperation and collaboration in all areas relevant to STI as well as Eco-innovation and to accelerate the transfer, adoption and adaptation of relevant technologies for transformational change in sub-Saharan countries. Whereas the case study countries have developed some institutional structures to support STI, there are still huge gaps/challenges in ensuring that these institutions deliver on their mandates. These challenges include lack of enough financial resources, infrastructure as well as the low capacity for these institutions to meaningfully support Eco-innovation. In addition, STI development should be harmonized with well-defined institutional structures that support concepts of Eco-innovation, green economy, and green growth and place great emphasis on the potential synergies between economic growth and environmental sustainability. It is crystal clear that collaborative efforts are better fast-tracked when all the elements in NIS are integrated. Despite having many business opportunities offered by African countries, it should be borne in mind that any eco-innovative business strategies developed within the African context should take into account the differences among countries in levels of development, their economic structures, and political and social environments. Unlocking eco-innovative commercial potentials across African regions, with well-designed and supportive policy and programmatic actions, should produce not only strong but sustainable growth. Africa can achieve such economic and social development if it is underpinned by a dynamic private sector and productive entrepreneurship. This, therefore, calls for strong policies that put in place systems and institutional frameworks that knit together the various actors

and stakeholders in a web that churns out Eco-innovations that will result in sustainable development for the African countries.

5. Policy Recommendations

Innovation requires support systems to enable interaction between companies, universities, and technical research institutions. Collaboration and cooperation lead to interactive learning, the flow of research and technology into industry for successful commercialization and diffusion of eco-innovative solutions. These interactions and diffusion do not take place in weak systems. The effectiveness of systems depends on efficient coordination and facilitation, a role that can be played by the government with the help of other actors. Below are some recommendations that may improve the Eco-innovation institutional framework.

Recommendation 1: Foster strong inter-ministerial coordination, including engagement of the national planning, finance ministries among others

Eco-innovation is a means to engage and enable industries and businesses to contribute to the achievement of broader national goals related to development, competitiveness, employment, and the environment among others. Therefore, the combinations of policies for Eco-innovation need to be strongly anchored in an overarching vision for the economy. Different ministries and their respective departments and agencies need to work together using a workable mechanism to ensure that Eco-innovation is strongly anchored and embraced. This can be through special inter-ministerial committees that have all sectors and actors involved.

Recommendation 2: Adopt life-cycle thinking and value-chain approach in the development of an institutional framework

Lifecycle thinking examines the impacts of goods and services over their lifecycle: from raw material acquisition through to manufacturing, distribution, product use and disposal. It refers to a qualitative approach to understanding how material resources flow through each stage of the lifecycle. It is closely linked to a scientific approach of lifecycle assessment but has been expanded to symbolize a system thinking perspective in addressing issues of sustainability. Identifying actors in each phase of the cycle is critical in setting up an all-inclusive structure that can support Eco-innovation. Different policy instruments target different phases of the lifecycle of goods that can be designed into policy interventions across the value chain. If applied at a macro level, it helps to identify specific issues, industries and value chains where actions are most

urgently needed to efficiently target the efforts and investments of public and private sectors. The value chain approach draws attention to sector-specific needs.

Recommendation 3: Institutional frameworks for Eco-innovation need to encourage collaboration amongst all actors

Eco-innovation relies on an interactive process between different partners in the value chain and within a system for Eco-innovation. Availability of interfaces for open and creative exchange and collaboration among stakeholders is essential to provide knowledge as input to Eco-innovation and to mobilize the right competencies required for systemic change. Policy measures for Eco-innovation should be formulated to encourage interaction and align the technical competencies of businesses and knowledge institutions. The active involvement of stakeholders is important to facilitate social acceptance of change and amplify the scale for Eco-innovation through productive links across value chain actors and different sectors. For example, facilitating collaboration between large and small companies, in which large companies comply with policies or programmes which encourage performance improvements among their suppliers, has been conducive to increased productivity and joint innovation. Collaboration could also unfold in platforms to identify technologies to match needs with existing solutions, establish testing centres and business incubation hubs for networking, explore and generate ideas, and assess and avoid related risks.

Recommendation 4: Institutional frameworks for Eco-innovation need to be designed to address long-term issues

Measures aiming at short-term reductions and improvements only result in incremental changes favouring sub-optimal levels of sustainability. Measures that do not provide a clear and coherent path to address long-term issues such as vulnerability from environmental and resource degradation and resource scarcity will not be effective in mitigating these risks. Policymaking needs to have a long-term strategic vision to show the direction in which the regulatory landscape is heading beyond the current election term. This is necessary not only to secure a form of sustainability based on the concept of intergenerational equity but also for industry to have clear signals to show them that investing in eco-innovative solutions is worthwhile. Eco-innovation is implemented by market agents who need a stable environment to take risks and a clear direction on where to focus on continuous improvements. Long-term orientation is an important frame of reference for decisions and collective actions and results.

Recommendation 5: Avail the necessary resources to institutions to develop infrastructure, purchase equipment and build their capacity to support Eco-innovation

The right infrastructure and laboratory equipment are vital for eco-innovators to efficiently and effectively carry out research and training. All the case study countries do not have sufficient institutions that provide training in Eco-innovation and limited research on the same is conducted due to lack of facilities and the necessary technical knowledge. There is need for the respective governments to tap into available opportunities nationally and internationally to develop these.

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Science Technology and Innovation for African Development

ISBN: 978-9966-124-80-7

