KENYA INNOVATION OUTLOOK STUDY 2022

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Kenya National Innovation Agency

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ACRONYMS

1NF	First Normal Form
2NF	Second Normal Form
3NF	Third Normal Form
4NF	Fourth Normal Form
ACA	Anti-Counterfeit Authority
AOSTI	African Observatory for Science, Technology, and Innovation
ARIN	Africa Research and Impact Network
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASSEK	Association of Start-up and SMEs Enablers of Kenya
ASTII	Africa Science Technology and Innovation Indicators
AU-NEPAD	African Union New Partnership for Africa's Development
Big4	Big Four (Big4) Agenda
CAK	Communication Authority of Kenya
CBD	Central Bank of Kenya
COMESA	Common Market for Eastern and Southern Africa
CSOs	Civil Society Organization
CUE	Commission for University Education
DPPC	Drug Policy and Planning Centre
EAC	East African Community
EARIH	East Africa Research and Innovation
EASTECO	East Africa Science Technology Commission
ECOWAS	Economic Community of West African States
EPZ	Export processing zones
EPZA	Export Processing Zones Authority (EPZA)
EU	European Union
FAO	Food and Agriculture Organization
FCDO	Foreign, Commonwealth & Development Office
FDI	Foreign Direct Investment
FTE	Full-time equivalent
FTTH	Fibre to the Home
FTTO	Fibre to the Office
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GII	Global Innovation Index
GIZ	German Agency for International Cooperation
IB	Innovation Bridge
ICT	Information and Communication Technologies
IP	Intellectual Property
IPR	Intellectual property rights
KATTI	Kenya Association of Technical Training Institutions
KCB	Kenya Commercial Bank
KECOBO	Kenya Copyright Board
KENAS	Kenya Accreditation Service
KeNIA	Kenya Innovation Agency
KenInvest	Kenya Investment Authority
KIE	Kenya Industrial Estate
KIO	Kenya Innovation Outlook
KIPI	Kenya Industrial and Property Institute
KNBS	National Bureau of Statistics, Nairobi, Kenya
KNCPC	Kenya National Congress of Pentecostal Churches
KNDMP	Kenya National Digital Master Plan
LMICs	Low- and Middle-Income Countries

MECS	Modern Energy Cooking Programme
MSEA	Micro and Small Enterprises and Authority
MTP	Medium-Term Plan
MVPs	Minimum viable products
NACOSTI	National Commission for Science Technology and Innovation
NEMA	National Environment Management Agency
NGOs	Non-governmental organization
NIS	National Innovation System
NORAD	Norwegian Agency for Development Cooperation
NRF	National Research Fund
OECD	Organisation for Economic Co-operation and Development
OM	Oslo Manual
PAIPO	Pan-African Intellectual Property Organization
PASGR	Partnership for African Social and Governance Research
PCT	Patent Cooperation Treaty
PPB	Poison and Pharmacy Board
R&D	R&D Research and Development
SACCOs	Saving and Credit Cooperative Society
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SMEs	Small and Medium-Sized Enterprises
STEM	Science, Technology, Engineering, and Mathematics
STI	Science, Technology, and innovation
STISA	Science, Technology, and Innovation Strategy for Africa
TTOs	Technology Transfer Offices
TTU	Technology transfer units
TVETs	Technical and Vocational Education and Training
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNHCR	United Nations High Commissioner for Refugees
UON	University of Nairobi
USAID	United States Agency for International Development
VAT	Value Added Tax
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

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EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

Context and Rationale

Kenya is currently riding on innovation as a key vehicle for economic growth, but there is no single consolidated platform in the country where innovation activities and progress can be updated and accessed; i.e., a real-time one-stop shop for key information on Kenya's current innovation status and outlook. Such a platform enhances the ability of the government, local stakeholders, and foreign investors to make rapid and evidence-based decisions regarding investments in innovation-related initiatives across the economy. Most importantly, the Kenyan innovation performance has been assessed, mainly, through the Science, Technology, and Innovation lens with the aim of international comparison based on global standards and indicators. There have been limited efforts to domesticate the indicators to make them more relevant, relatable, understandable, and usable by local decision-makers. Innovation is quite a big concept that would take a huge effort to unpack. The danger is in taking a narrow view of it and missing the broader dimensions. The report at hand does indeed take in this broader angle, but inevitably emphasis differs for the various issues it discusses. Far too many social problems are crying out for solutions, and creative approaches are needed to deal with them. Innovation, therefore, must be seen as a vehicle for the transformation of society for the attainment of better standards of life and more dignified involvements by the productive population in the economy.

The definition offered, *"a process that involves the conception of ideas through to translation into products and impacts"* is broad enough but care must be taken not to understate the impacts in favor of products. Innovative outcomes will be manifested not just in products that then go to market, showcasing the main technological breakthrough, but also in societal impacts that contribute to the quality of life in whichever way.

This inaugural Kenya Innovation Outlook (KIO) study is a step towards co-developing (i.e., with a broad spectrum of stakeholders) a contextual framework and suitable indicators for measuring innovation performance. The KIO provides a template that can be used and regularly improved in assessing the country's innovation. The study was funded by the Foreign, Commonwealth & Development Office (FCDO) and technically led by the Africa Research and Impact Network (ARIN), in close consultations with the Kenya National Innovation Agency (KeNIA).

Study Framework

The study design is anchored on the understanding that innovation systems and associated indicators are embedded in a process that involves the conception of ideas through to their translation into goods, services, business models and impacts on the economy and society.
The KIO 2022 is sub-divided into six domains that capture Kenya's innovation status and opportunities for investments:

1. *National and Global Policy and Economic Context*: defines how innovation is aligned to Kenya's development and policy context.
2. *Innovation life cycle/value chain:* includes platforms and activities that directly drive the progression of innovation, from conceptualization, development, commercializing, uptake, and impact realization.
3. *Investments*: includes financial and infrastructural investments from both state and non-state actors.
4. *Incentives*: includes economic and legal initiatives (incentives) that the government and other players have established specifically to enhance innovations (e.g., tax breaks or credits).
5. *Impacts*: includes resultant economic, social, ecological, and political impacts of innovations.
6. *Impediments*: includes barriers to the value chain, including cheap imports that price out local innovations from the market.

Key Highlights

The "National and Global Economic and Policy Outlook" domain, include six (6) prioritized indicators (e.g., extent of Citation/consideration of innovations in economic blueprints, presence of a dedicated innovation Agency, Availability and effectiveness of coordination mechanisms, among others). Indicators related to innovation policy were prioritized as key to understanding the innovation process and strengthening innovation supporting activities. Innovation is highlighted in Kenya's Vision 2030 and other blueprints even though there is no consolidated visibility of the innovation agenda in these blueprints. The country is making good progress in the innovation policy domain anchored on the ST&I Act of 2013, but most policies and plans are regulatory rather than facilitative. More effort is required towards strengthening a balanced mix of framework conditions for innovation (e.g., research performance and commercialization policies and/or strategies that facilitate marketization of research outputs especially in the informal sector since this study focused more on market-driven innovation). Kenya is part of regional and continental strategies such as the STISA 2024 and Agenda 2063, to name a few examples, but there are no clear guidelines to evaluate national progress in implementing these frameworks in line with national development plans. The country's innovation governance is strengthened by the presence of a dedicated agency mandated to promote innovation, the Kenya National Innovation Agency (KeNIA). There are other agencies, but our findings show that the governance structures are mostly focused on the regulatory functions and less on the facilitative functions (e.g., marketization, funding, etc.).

The "Innovation Life Cycle/Value chain" domain includes twenty-eight (28) prioritized indicators (e.g., number of innovation knowledge platforms, source of funding (private or government), number of Science, Technology, Engineering and Mathematics programmes (by level), number of publications and patents, and number of commercialized knowledge products. The indicators related to knowledge commercialization were prioritized as key for assessing the translation of knowledge and technology into usable or marketable goods, services, and business models. The findings show that Kenya's knowledge-producing platforms are not limited to Universities and TVETS, but also other government and private research institutions that support innovation are increasing in number and associated enrolments. This has increased the number of research outputs/publications and patents and hence the innovative ideas. Platforms for commercializing these ideas are becoming prominent, more so, in the enterprise sector (e.g., start-ups and incubation centres) but remain relatively weak in the academic sector.

There have been efforts to support the establishment of Technology Transfer Units (TTU) in Universities and Research Institutions through the Kenya Industrial and Property Institute (KIPI) and KeNIA, as a route to commercialization. However, most of the existing TTUs are not operationalized and are relatively under-skilled and characterised by low sensitization, especially among researchers who lack information on patenting and Intellectual Property (IP) rights. Compared to the TTUs, start-ups and incubators appear to accelerate commercialization owing to their stronger interactions with the external market environment. Several efforts toward strengthening commercialization are emerging including the Innovation Bridge platform established by KeNIA, aimed at exposing research innovations to the market. Uptake and awareness creation platforms such as Innovation Weeks and other digital platforms in the ICT and other sectors are increasingly becoming important in linking innovative ideas and products to potential markets.

The ''Investments'' domain included prioritized indicators (e.g., share of GDP invested in R&D, amount of private sector funding and amount of foreign direct investments supporting innovation, among others). The study shows that the national budgetary allocation to ST&I remains low. However, there is increasing infrastructure investments in the country, especially in digitization and electricity connectivity, which are key enablers, but the lack of adequate funding means that this infrastructure cannot be adequately accessed and used by various segments of the society especially rural dwellers and other disadvantaged social groups. While Kenya has put in place special funds such as women and youth funds, the extent to which innovation is mainstreamed in these funds is unclear. However, findings show that there is increasing foreign investments and funding of hubs and start-ups in Kenya, an opportunity that could be enhanced by creating a safe business environment for foreign and local investors. Kenya has made efforts in easing the establishment of business through the e-citizen platform. However, political stability remains a threat to business growth.

The ''incentives'' domain included twelve (12) prioritized indicators (e.g., innovation awards and special economic zones, among others). While the country has put in place various incentive schemes such as innovation awards, incentives related to facilitating business processes were highlighted as key in creating wider impacts, especially on commercialization and enterprise development. Additionally, innovation awards have been established, even though these are small in scale, to spur the development of innovative ideas, but their impacts remain unclear and untracked. There is a need to develop an incentives strategy such as financial incentives, tax credits and intellectual property incentives, with clear budgetary allocation, coordination, and impact tracking system.

The ''impacts'' domain included eleven (11) prioritized indicators (e.g., number of jobs created, ecological impacts on carbon footprints, among others). Findings show that currently, there is no framework for measuring the impacts of innovation. The ''economic impacts'' subdomain was prioritized especially the role of innovations in job creation and economic growth. On the other hand, there are multiple social and ecological impacts (e.g., reduced carbon footprints through cleaner production) but they are often overlooked due to the focus on economic impacts.
Finally, the ''impediments to innovation'' domain included six (6) prioritized indicators (e.g., structural inefficiencies such as corruption, incompetence, and cultural barriers such as beliefs and traditions, among others.)

Indicators related to ''structural inefficiencies'' were highlighted as they pose significant challenges to innovation performance in the country. Findings show that structural inefficiencies especially incompetence and corruption are key impediments to innovation, resulting in poor management of ideas supportive to innovation and ushering in counterfeit products.

Recommendations

Based on stakeholder prioritization and ranking, frontier sub-domains were identified in each of the domains. These form the basis for the following recommendations:

A well-articulated innovation policy is highlighted as key to understanding and catalyzing innovation supporting activities. There is an opportunity to transform the country's innovation capacity through establishing more facilitative policies (e.g., commercialization guidelines, strategies etc). This study recommends the **development of a long term National Multi-Sectoral Innovation Masterplan and an effective framework for various innovation financing schemes.**

An elaborate mechanism should be developed to effectively manage ideas supportive of innovation, execution of ideas and utilization and/or commercialization of results. Kenya has an opportunity to turn huge amounts of research results into market products that could spur economic growth and job creation. Enhancing funding and capacity development for the various **commercialization units such as TTOs and incubation centres (within academic and research platforms) is a strategic investment.**

Funding is a critical part of Kenya's innovation outlook. **There is need to increase public funding for knowledge generation and use for innovation supporting activities through models such as outcomes-based funding focused on specific deliverables. Further, establishing university-led enterprises could enhance the private sector uptake of innovative research outputs.**

Incentivising business processes, for example, the ease of doing business, is important for Kenya's Innovation Outlook. **There is need to develop an institutionalized business incentive strategy with clear budgetary allocation, coordination, and impact tracking system.**

Economic impact of innovation remains key in linking innovation to the country's development goals. Nonetheless, there are no frameworks to track economic impacts of innovations. **There is need to align or strengthen the innovation outlook with the national economic outlook to establish clearer connections.**

Structural inefficiencies such as corruption and incompetence are key impediments to innovation in Kenya. **There is need for effective government institutions and governing systems with a clear legal and institutional framework and implementation of certain systemic reforms, including those that deal with infringers and protects innovations from piracy and counterfeits.**

Conclusion and next steps

Kenya's innovation outlook is relatively complex and still requires continuous coordination and consolidation. It is worth stressing that the scope of this study as well as its empirical basis is limited, as the findings are based on national level indicators with limited in-depth sectoral analysis. The study has nonetheless succeeded in working with stakeholders to develop an inaugural contextual framework and foundational indicators which Kenyan decision makers and stakeholders can further develop and apply in tracking innovation progress and decisions. This report provides a useful initial template for assessing, understanding, and coordinating Kenya's innovation activities.

Some of the next steps to take include:

1

Further development of granular economic sub-sector innovation performance data collection methods (particularly, digital) and updating of the missing data for different domains.

2

Deep-dive analytics profiles for specific sub-sectors at municipal, county, and national levels in the context of the identified critical sub-domains.

3

Future innovation outlooks might focus on specific areas especially the critical (sub) domains identified in this study to generate a deeper understanding of innovation dynamics, challenges, and investment opportunities.

4

·Linking the outlook study with the Innovation Bridge initiative to help continuously update data on innovations and showcase innovation as a mechanism for creating socio-economic value in the country and data.

5

Collection of data to measure innovation in the informal sector and of social innovation not amenable to classical R&D indicators remains a challenge and there is need for a longer and well-resourced study to populate this facet of the innovation outlook.

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BACKGROUND

2 BACKGROUND

2.1 DEVELOPMENT POLICY CONTEXT

In 2008, Kenya launched an ambitious long-term development strategy to become a globally competitive and prosperous nation by the year 2030. In recognition of the central role that Science, Technology, and Innovation (ST&I) plays in a modern economy such as boosting wealth creation, social welfare, international competitiveness, and the attainment of Sustainable Development Goals (SDGs), Kenya has acknowledged ST&I as one of the foundational enablers of "Vision 2030". Following the launch of Vision 2030, the mainstreaming of ST&I in the country's development strategy has been operationalized through various policies and acts of parliament. Some of the key policies and instruments are the ST&I Policy and Strategy of 2008, the STI Act of 2013, and more recently, the Big Four (Big4) Agenda and the Kenya National Digital Master Plan 2022-2032, which guides the country's ICT deployment and investments. The 2013 ST&I act underpinned the creation of a triple helix of ST&I oversight entities: the National Commission for Science Technology and Innovation (NACOSTI) to oversee the regulation of the national ST&I system; the National Research Fund (NRF) to manage research funds; and the Kenya National Innovation Agency (KeNIA) to facilitate the commercialization and uptake of innovations. The country's Medium-Term Plan (MTP) tracks progress on Vision 2030 through five-year cycles. The current MTP shows that the country has experienced an increasing economic growth in the last decade. Among the key areas being tracked as part of understanding progress under the MTP is the growth of the ST&I sector.

2.2 ECONOMY

Kenya's economy is largely market-driven and anchored on innovations such as digital technology and commercialization.

Kenya is the seventh largest economy in Africa. Kenya's economy is primarily market-based and is driven by agriculture, which contributes 33% of the country's Gross Domestic Product (GDP), (mainly export of cash crops such as horticulture, coffee, and tea, among others) and tourism contributing 5.7% of the GDP. However, there is an increasing focus on innovation and technological transformations as key enablers for investments and service delivery. Through various regulatory reforms, the government of Kenya is focused on enhancing the business environment to enable local and foreign investments. Such initiatives include the creation of export processing zones, and supporting innovation hubs, for example, the Konza Technopolis, with special investment incentives and the creation of jobs. The country's GDP has been increasing over the last decade at an average of 5%, even though this growth was staggered by the impacts of COVID-19, slowing down from 5.2% in 2019 to -0.3% in 2020. However, in 2021, the country recorded a 7.5% economic growth increase that was driven by the COVID-19 recovery strategies, and to some extent, innovations in the services sector and industrial output (World Bank, 2022). Although Kenya's direct trade with Ukraine is relatively moderate, the economy is vulnerable to the commodity price shocks caused by the ongoing war between Russia and Ukraine. Kenya is a net importer of oil, thus an increase in the global oil prices translates to an increased cost of living. Due to the economic risks posed by the war in Ukraine, the projected economic growth for 2022 and 2023 is relatively lower than the 2021 rate at 5.5% and 5.2% respectively.

2.3 DEMOGRAPHY

Kenya's demographic dividend presents an opportunity for transforming innovation through new ideas, the adoption of emerging technologies such as digitization, and a stronger labour market.

Kenya has a predominantly young population with about 60% under the age of 18-35 years. The current population size stands at 56.2 million, ranking 26th in the world and seventh in Africa. The country's average annual population growth rate is 2.28% per year. The youthful population has been identified as a major opportunity for spurring innovation and digital transformation due to their vibrancy and readiness to learn new ideas and adopt new technologies.

2.4 EDUCATION

Kenya's education sector is a key foundation for innovation and remains a key catalyst for scaling up emerging innovations and value addition.

The country's literacy rate stands at 81.5%, ranking among the top 10 in Africa. Over 16 million children and youth are enrolled in about 90,000 pre-primary, primary and secondary education institutions, and another 0.6 million are enrolled in post-secondary, i.e., tertiary institutions such as colleges, TVETs, and Universities. The number of TVETs and tertiary education institutions doubled, as did enrolment numbers in tertiary institutions in the past decade. Provision is mostly public; enrolment in public institutions accounts for 70% of total enrolment in pre-primary, 84% in primary, 93% in secondary, and 82% in tertiary education. According to the World Bank's assessment of Kenya's economic outlook, the education sector outputs contributed significantly to the increase in the service sector value-added by 9.8% in 2021.

2.5 INNOVATION ASSESSMENTS

While Kenya's innovation landscape has been mainly assessed through the wider ST&I lens based on global standards and indicators, there have been limited efforts to employ contextually-relevant indicators that are easily understandable and usable to decision-makers.

The first attempt to map out the status of the country's ST&I sector was through the 2009/2010 national ST&I indicator survey. Additionally, the country has been a beneficiary of several strategic ST&I studies supported by international partners especially the Foreign, Commonwealth, and Development Office (FCDO), through the East Africa Research and Innovation Hub (EARIH). These include a study on ST&I Metrics in Africa supported through the EARIH to help governments, investors, and donors to make better choices regarding ST&I investments using available ST&I indicators[1].

Similarly, the knowledge systems and innovation study commissioned by the FCDO through the East Africa hub provided a comprehensive assessment of the ST&I landscape in Kenya, Rwanda, and Tanzania using the knowledge systems lens . Recently, the East Africa Science Technology Commission (EASTECO) and ARIN collaborated in a research study to develop a country-specific web-based ST&I indicator for the region, with Kenya as a priority country . More broadly, Kenya is involved in various regional and international ST&I fora such as the Africa Science Technology and Innovation Indicators (ASTII), which aims to strengthen the capacity of African countries to collect internationally comparable ST&I indicators (see Figure 1). These studies show that Kenya has a relatively high innovation potential compared to other African countries, and according to the Global Innovation Index 2021 (GII, 2021), the country ranked fourth in Africa. Overall, most assessments have focused on general ST&I indicators based on international standards, e.g., the Frascati and Oslo Manuals, and there have been limited efforts to break these indicators into granular forms relevant to the context and easily understandable and usable by decision-makers.

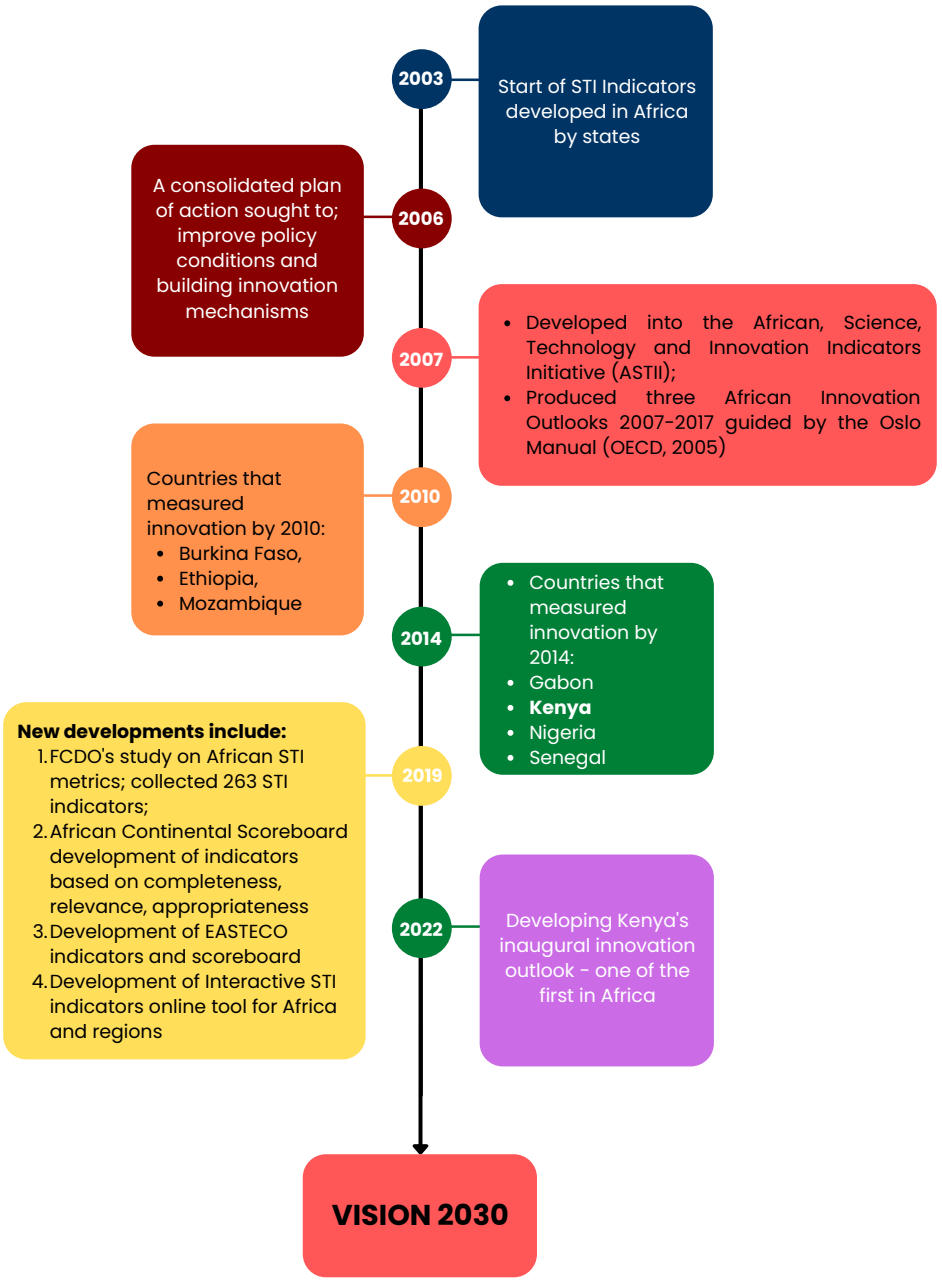

Figure 1: Timeline of past initiatives to measure science, technology, and innovation in Kenya

[1] https://www.arin-africa.org/2020/07/16/science-technology-and-innovation-sti-metrics/
[2] https://www.arin-africa.org/2020/07/16/knowledge-systems-and-innovationksi/
[3] https://www.arin-africa.org/2022/02/12/developing-the-east-african-regional-sti-indicators-and-web-based-electronic-database/

2.6 RATIONALE OF THE KENYA 2022 INNOVATION OUTLOOK STUDY

Despite the country riding on innovation as a vehicle for economic growth, there lacks a single consolidated platform where innovation activities and progress can be updated regularly to serve as a one-stop-shop for information on Kenya's current innovation status and outlook. This hampers the ability of the government, local stakeholders, and foreign investors to make rapid and evidence-based decisions regarding investing in Kenya's ST&I sector. This inaugural Kenya Innovation Outlook study provides a foundation for tracking innovation processes and activities thereby strengthening the coordination and investments in strategic innovative activities. The outlook, therefore, serves several strategic purposes as outlined in Figure 2.

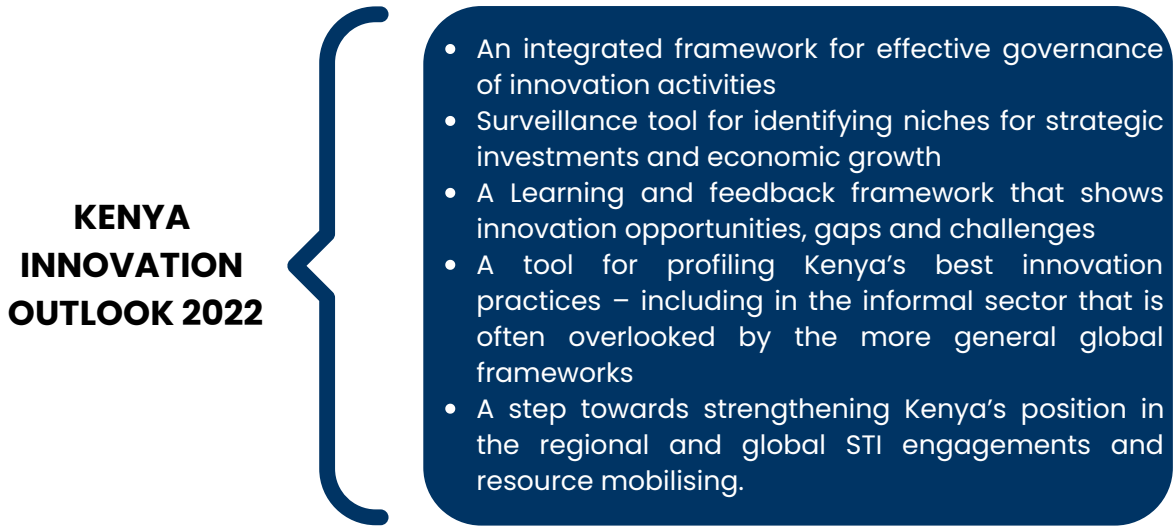

Figure 2: Rationale for Kenya Innovation Outlook development 2022

2.7 OBJECTIVES OF THE KENYA 2022 INNOVATION OUTLOOK STUDY

This Innovation outlook report was commissioned by the EARIH in partnership with KeNIA to develop a comprehensive overview of Kenya's innovation landscape and its evolution over the past 5-10 years. The aim is to inform KeNIA and other stakeholders, including FCDO, ST&I policy makers, analysts, and potential investors about the trends and opportunities in the innovation landscape. It is expected that the high-quality, contextual evidence collated in the study will augment KeNIA's efforts in promoting innovation in Kenya, facilitate partnerships across diverse ST&I stakeholders, and steer investments toward the country's ST&I sector. In turn, this will drive enterprise development and economic growth. Most importantly, the report provides a baseline against which progress in Kenya's innovation outlook can be measured going forward.

2.8 The process of developing the outlook study

The study involved nine (9) key steps focused on conceptual understanding, data collection and analysis, and co-creation of sets of relevant indicators based on stakeholder consultations and global innovation frameworks (Figure 3).

Figure 3: Approach to developing Kenya's Inaugural Innovation Outlook

2.9 THE ORGANIZATION OF THE REPORT

This report is organized into five main sections. This introductory section sets the context for Kenya's innovation environment. The second section outlines the conceptual framework underpinning the outlook. In the third section, the innovation indicators are described and analyzed based on the framework, while the fourth section presents a consolidated scoreboard with innovation indicator domains and sub-domains. Key opportunities and challenges to innovation in Kenya including potential interventions are outlined in the fifth section.

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CONCEPTS AND DEFINITIONS

3. CONCEPTS AND DEFINITIONS

3.1 DEFINING INNOVATIONS

The definition of innovation for measurement purposes is anchored on ''new improved products/processes'' introduced on the market or put to use, but in the Kenyan context, the emphasis is largely on interventions, with disruptive positive effects on the economy, i.e., jobs, markets, and poverty reduction. Developing a robust and functional innovation outlook requires an understanding of what innovation entails (both front-end and back-end) and why innovation is a key factor in supporting the economic development of countries (Hall et al. 2020). Despite the claims of innovation at all socio-economic levels from national, sectoral, institutional, and individual levels, there is no universal definition of innovation because it is relatively contextual and dependent on interpretation by different actors; academia, manufacturing, service providers, community-oriented organizations, and artists, among others. The varied definition of innovation and the need to have share understanding what innovation entails for Kenya, inspired this outlook. The first steps of the outlook are intended to contextualize innovation and the associated indicators to encourage a deeper understanding and mechanisms for effective utilization among different actors, decision-makers, and investors, to name a few examples.

Nonetheless, the Oslo Manual for collecting, reporting, and using data on innovation (OECD/Eurostat, 2018) defines innovation as *''new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations''*. Some literature review, for instance, Taylor et al., (2017), provides an in-depth review of the evolution of the term innovation, which contrasts with imitation and provides a composite definition of innovation as "the creative process whereby new or improved ideas are successfully developed and applied to produce outcomes that are practical and of value". These definitions have elicited debates about whether an ''innovation'' is primarily associated with novelty and dramatic technological breakthroughs. The notion of dramatic change led to the perception that innovation only happens through formal knowledge, technological, or market processes and may not include informal processes that are increasingly driving economic development. Given the dynamic economic environment, the need to diversify sources of income, and recover from the effects of the COVID-19 pandemic, countries are moving towards a more holistic view of innovation to focus on both formal and informal products and processes.

In the Kenyan context, the 2013 ST&I Act provides a more inclusive framing of innovation succinctly captured in five parts: "(a) a technovation model, utility model, or industrial design within the meaning of the Industrial Property Act, 2001 (Cap. 509); (b) a product, process, service or idea which is novel; (c) an improved use of a new product, service or method in the industry, business or society; or (d) indigenous or traditional knowledge by the community of beneficial properties of land, natural resources, including plant and animal resources and the environment; (e) any other non-patentable creations or improvements which may be deemed as deserving promotion and protection or sui generis intellectual property rights and "innovator" shall be construed accordingly". Through this definition, Kenya aspires not just to pursue innovative ideas and technologies but ensure that these innovations respond to the country's economic growth and poverty reduction as also stressed by Hall et al., (2003).

Innovation can also be categorized into different typologies based on the focus. Three typologies have widely been used in previous assessments:

- ***Process innovation*** defined as the implementation of a new and novel approach /method in a firm or institution, e.g., co-creating an idea with consumers to enhance market uptake;
- ***Product innovation*** which involves the creation of a new product brand or improving an existing brand to enhance utility and respond to consumer needs is an impactful way, e.g., smartphones or even a vaccine; and
- ***Organizational innovation*** which is synonymous to institutional innovation and involves new organizational structures and policies that enhance effective management and satisfactory service delivery to consumers/stakeholders. These forms of innovations can occur on different platforms including outside firms, in public spaces, and in educational spheres, and generate development and create wealth (GoK, 2012).

For the Kenya Innovation Outlook (KIO), we have therefore drawn from the various definitions described above (also see Figure 4) to propose a definition of innovation that is context relevant: "Creation of new or distinct improvement of products and processes in the formal and informal sector that have disruptive positive effects on the economy, and the social well-being of the citizens".

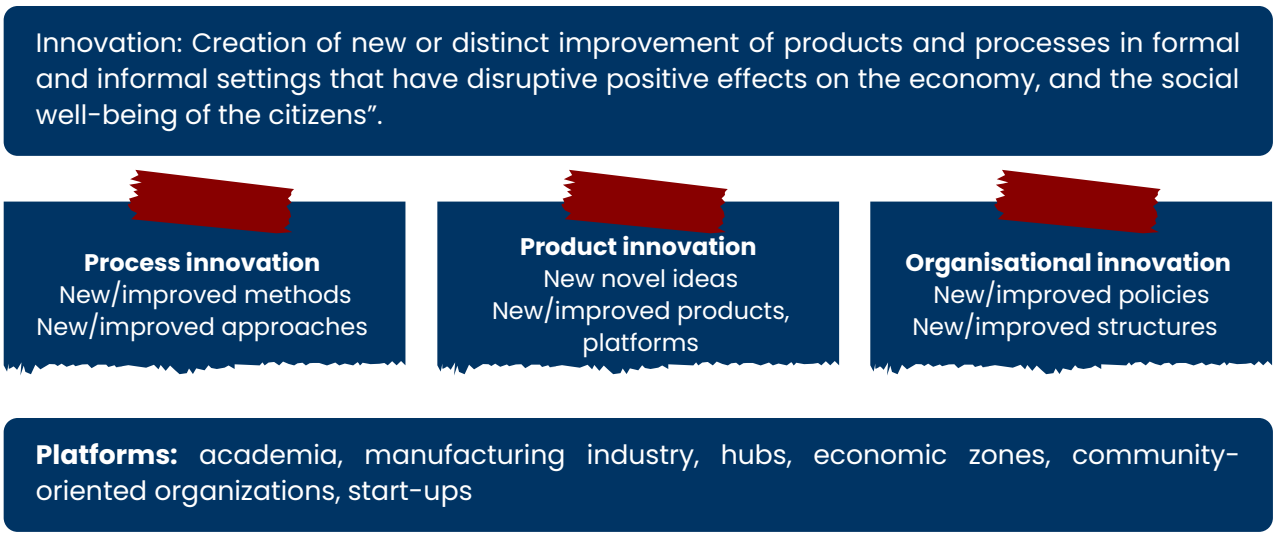

Figure 4: Definition of innovation for the KIO 2022

3.2 DEFINING NATIONAL INNOVATION SYSTEMS (NIS)

Innovation is not a linear process, but a more complex system that requires a clear understanding of the actors and associated processes involved including inputs, outputs, enablers, impacts, and associated strategic niches. The interactions between different actors and processes that underpin innovations are encapsulated in the National Innovation Systems (NIS). While the conception of innovative ideas is normally the exercise of individuals or discrete teams, innovation does not happen in isolation but is rather facilitated through and impacted by a multi-scale, complex, and dynamic network of social, legal, political, and economic factors. Furthermore, innovation as a non-linear systemic process requires feedback loops and multiple linkages across various policy, technological and market interventions at various levels and within relatively complex social-economic contexts (Leach et al., 2012). This intricate network collectively constitutes an innovation system that can be demarcated at increasingly wider and more complex scales ranging from local, national, and regional to a global scale; thus, allowing comparisons across systems (Rudskaia et al., 2018).

The use of the term "national innovation system" started gaining traction in development discourses in the 1980s. As is the case with the term "innovation", multiple definitions of NIS have emerged over time. A common definition from literature is that the NIS *"is a network or a system of interacting government and private companies (large and small), universities, government bodies whose activities and relations lead to the emergence, import, perfection, and spread of new technologies within national borders".* The cooperation of these organizations can be technical, commercial, legal, social, and financial, while the goal is the development, security, financing, and regulation of new areas of knowledge and technology. The key point in this definition is the relationships and interactions among institutions and resultant impacts.

3.3 Evaluating National Innovation Systems

The urge to evaluate any NIS is driven by both internal and external utility demands. Internally, countries need to constantly monitor the outcome and impact of their innovation activities on socio-economic development. The evidence from tracking progress informs the establishment of innovation governance structures, formulation of policies, and budgetary allocation to maximize benefits from the investments within their NIS. Externally, the evidence informs the ranking of countries on the global innovation index, which is also a measure of the countries' economic competitiveness. This in turn provides potential investors with a basis for selecting countries and sectors to invest in and is, therefore, a major booster for both internal and foreign direct investment.

To facilitate comparison between NIS across the globe, several international assessment tools have been adopted. The first attempt to provide harmonized indicators for measuring NIS was done in 1962 by the Organisation for Economic Co-operation and Development (OECD) Working Party of National Experts on Science and Technology Indicators. The series of statistical manuals they generated are popularly known as the "Frascati family" of manuals, in reference to the Italian town where they were first developed. Of these manuals, the Oslo Manual has been the international standard of reference for conceptualizing and measuring innovation since 1992. It has since been revised on three occasions to account for growing levels of understanding and adoption, the emergence of innovation frontiers, and to address evolving user needs.

Several previous innovation assessments in Kenya and elsewhere in Africa, including the third generation Africa Continent Innovation Outlook 2019, the Kenyan Innovation outlook Report 2012, and the Kenyan innovation Survey 2015, have all applied the Oslo Manual. Prior to 2018, the innovation surveys according to the Oslo manual mainly focused on collecting data from the formal business sector.

However, the revised Oslo Manual (2018) provides guidelines for measuring innovation in all sectors of the economy including the public sector and households. Countries should develop innovation data collection instruments that cover sectors of the economy such as government ministries (departments and agencies), education institutions, health institutions (e.g., clinics, hospitals, etc.), research institutions, consumers/Individuals, and groups not acting as a firm, social interest groups, and professional interest groups. Given that innovation is embedded in formal and informal platforms with local markets, social, technological, governance, and organizational processes, all form key parts of an innovation system. It is recommended that these international manuals be adapted to the local context. Our approach, therefore, expands the delineation of the innovation space to include formal and informal innovation platforms and processes. Overall, the term innovation is nuanced with multiple terms and concepts that can be well understood as the concept becomes more practical. Some of the key terms that underpin innovation are outlined in Text Box 1.

Textbox 1: Glossary of Terms ***(OSLO MANUAL 2018 © OECD/EUROPEAN UNION 2018; UNHCR)***

- **Innovators:** People who are able to see how a new idea, or an existing idea or invention could be exploited into an outcome that creates value for people.
- **Innovation:** The implementation of a new or significantly improved product (good or service), process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.
- **Innovation ecosystem:** Complex network of people, organisations, institutions, government policy and regulations that support and promote innovation. It includes the interactions between people in order to take an idea and turn it into a marketable process, product or service.
- **Technology:** Is the state of knowledge on how to convert resources into outputs. This includes the practical use and application to business processes or products of technical methods, systems, devices, skills, and practices.
- **Intellectual property (IP):** Creations of the mind such as inventions; literary and artistic works; and symbols, names and images used in commerce.
- **Intellectual property rights (IPRs):** Legal rights over intellectual property.
- **Accelerator:** An effort to develop a business idea, test that idea, and essentially treat the idea as a new business startup, pursuing the idea or ideas over the course of a few months.
- **Incubator:** Help start-ups in their infancy succeed by providing workspace, seed funding, mentoring, and training.
- **Startup accelerator:** An organization that offers mentorship, capital, and connections to investors and business partners. Its is designed for select startups with promising minimum viable products (MVPs) and founders, as a way to rapidly scale growth.
- **Innovation lab:** Also known as hubs, incubators, or accelerators (a co-working space), both virtual and physical, in which new ideas can be explored, in which hands-on project management takes place, and in which lessons learned are documented and shared with the co-owning Division (UNHCR). Innovation Labs are also a space from which the scaling of good practices can emerge.
- **Prototype:** A small-scale, tangible representation of an idea or solution (or part of it) that people can directly experience. Prototyping allows you to communicate your idea or solution to others in an interactive way, try ideas out quickly and gather feedback easily. The prototype is tested to make sure it is fit for the purpose and users' need. Based on the feedback, the prototype is improved and tested again.
- **A startup:** Newly formed business with particular momentum behind it based on perceived demand for it.

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METHODOLOGY

4 METHODOLOGY

4.1 FRAMEWORK FOR EVALUATING THE KENYA INNOVATION OUTLOOK 2022

The national innovation system is complex. For evaluation purposes, this can be better understood through a framework as shown in Fig 6, that systematically unpacks the relevant domains, sub-domains, and activities in the innovation process. Drawing from the definitions of innovation and a national innovation system, previous assessments, and discussions with stakeholders, a context-appropriate framework that describes Kenya's NIS was developed to guide data collection, analysis, and presentation. This framework can be improved in subsequent outlook studies based on emerging knowledge. At the core of the framework are six interlinked domains that define the innovation system and several sub-domains. These sub-domains are used to understand the context within which innovation takes place and identify the relevant indicators. The domains and subdomains are presented in Figure 5 and their interactions are depicted in Figure 6.

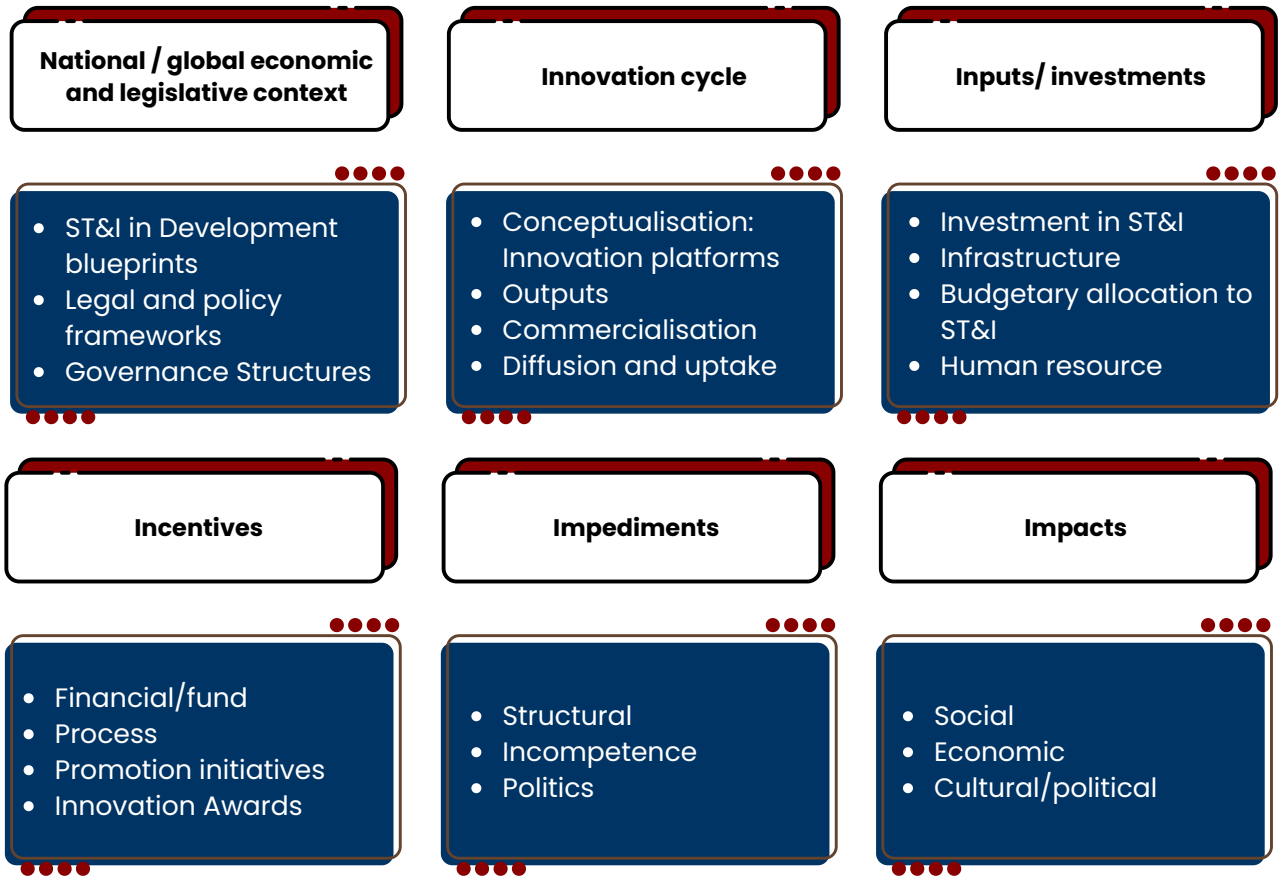

Figure 5: Domains and subdomains for the KIO 2022 Framework

Domain 1, National and Global legislative and Economic Context: involves the context within which innovation happens. National Innovation is mainstreamed through various national development blueprints and governed through national legislative and regulatory frameworks that define ST&I structures, accreditation standards, policies, and guidelines. The framework recognizes that for sustained resource allocation, ST&I must be integral to the national development vision and formally spelt out clearly in the country's development blueprints. In addition, national innovation systems operate within a global market space that is defined by international trade treaties.

Domain 2, Innovation life cycle/value chain: is about the platforms and activities that directly drive the progression of innovation, from conceptualization through development, commercializing, diffusion, and uptake. Conceptualization of innovative ideas happens in several places such as communities, households, universities, TVETs, research centres, commercial enterprises, and non-government organizations. The outputs (test products, new processes, and knowledge) from these platforms may be consumed internally by the producers or be taken up for further development and scaling up in commercialization platforms including innovation incubators, special economic zones, and private companies. At the state level, the innovation cycle is sustained through inputs such as budgetary allocation for ST&I, development of specific infrastructure (such as putting up research facilities and laying internet connections), and investments in education.

Domain 3, Investments: involves the inputs that are part of the critical drivers of innovation, for example funding, infrastructure, equipment and software, and R&D activities. Funding includes both private and public funds available in the country as well foreign funds. There may exist different types and forms of funds such as private equity, loans, grants, and special funds, among many. Infrastructure on the other hand is a key enabler for innovation. There is various infrastructural support such as a knowledge infrastructure. For purposes of this outlook, we identify digitalization and access to electricity as some of the key drivers and enablers of innovation activities.

Domain 4, Incentives: involves economic and legal initiatives (specifically, incentives) that the government and other players have established to enhance innovations (e.g., tax breaks or credits) by reducing costs and bureaucratic barriers to scaling up and commercialization. These also include innovation awards aimed at encouraging innovations, among others.

Domain 5, Impediments: involves factors that prevent the progression of innovations through the value chain to commercialization and scaling up including cheap imports that price out local innovations from the market, and costly financial and time inputs occasioned by corruption and incompetence, which reduce the market competitiveness of local innovations.

Domain 6, Impacts: which constitute the impacts of innovations. Any investments in innovation are expected to deliver socio-economic development benefits to citizens in most need. Such impacts include but are not limited to social wellbeing but extend to include the emergence of new networks and partnerships, job creation and demonstrable contribution to the GDP, political stability, and environmental sustainability.

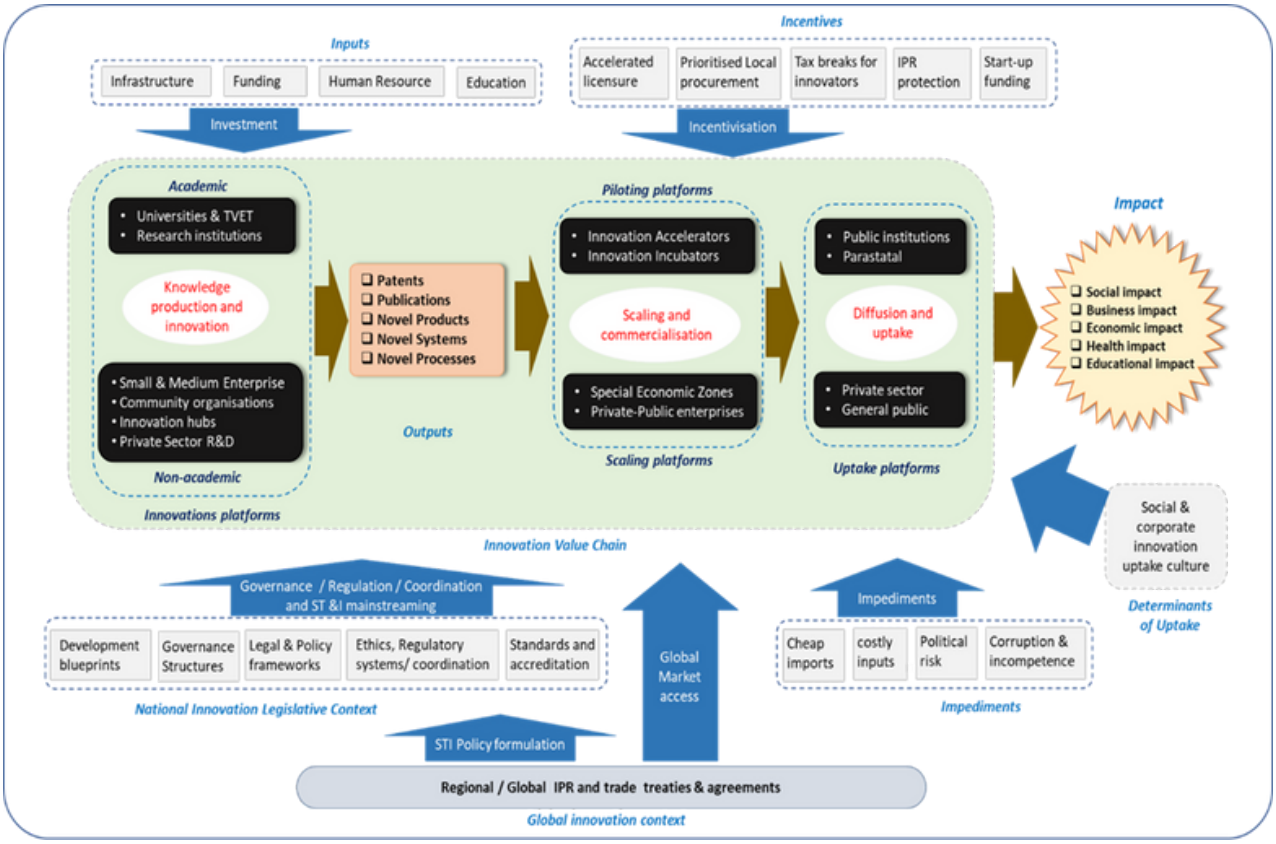

Figure 6: Innovation system Framework for the Kenya Innovation Outlook 2022

4.2 APPROACH TO DEVELOPING THE SCOREBOARD FOR THE KIO 2022

A scoreboard will provide a way for organizing and presenting specific indicators for the KIO 2022, in line with the identified domains and sub-domains. An innovation scoreboard has been used in different studies to present national, regional, or global innovation performance in a format that allows rapid review of the country's innovation status and comparisons with other countries, or the examination of national transitions. The scoreboard can indicate a composite single index such as a country's Global Innovation Index or allow individual components of the innovation system to be examined and compared.

The first step to developing a scoreboard is to identify the indicators that best reflect the status and performance of an innovation system (Figure 7). For this study, the identification of the indicators was guided by the framework and is discussed in more detail in the methodology section. Stakeholder consultations were carried out to identify indicators related to the specific domains and sub-domains. A detailed list of indicators was shared with eighty (80) stakeholders to assess their relevance. Through the stakeholder engagement, a list of indicators was developed, and the corresponding data was collected.

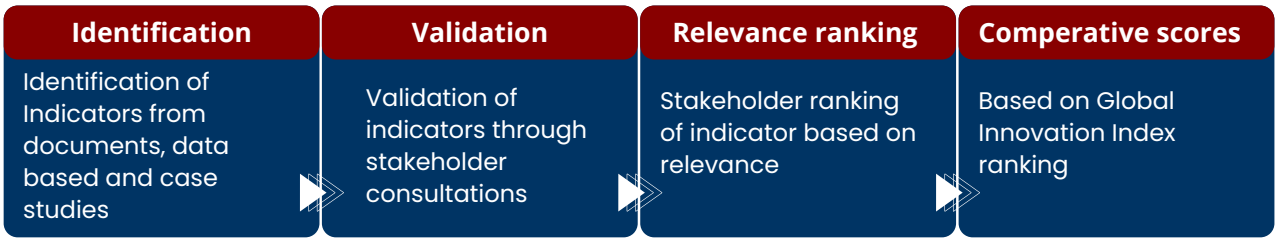

Figure 7: Comparative scores – Country Ranking (where data availability allows)

Some of the data collated were already in formats that can be used to compare across countries, but a significant amount of data was not comparable across countries or time in their raw format and highly contextual nature. As such, two main approaches were employed to generate comparable scores, i.e., a) for indicators related to policies or governance structures, the existence or absence of a policy or structures was assigned a score of 1 or 0 respectively, and the summed-up score for all the existing policies or structures indicated the performance of the innovation policy indicator; b) for quantitative data such as enrolment in tertiary education, normalization was done by dividing the data by the base population and presenting as per capita students enrolled (or enrolment per 1 million citizens) to allow comparison between countries or periods with varying populations. To give a rating of the country's innovation performance, the scores for each indicator were further ranked against other country scores or categorized as high, medium, or low relative to the global distribution of scores or a set global/regional standard. Full details of how each score was generated and ranked are provided in Annex 2.

4.3 DATA COLLECTION

The data collection approach adopted was based on the NIS framework shown in Figure 6. The high-level components of the framework (labeled in blue text) were designated as domains and the elements within each domain as subdomains for which indicators were developed. This framework does not exclude other ways of describing Kenya's NIS, and the approach adopted is aimed at maintaining coherence and understanding presented in the outlook.

To assess each of these domains and subdomains, a set of specific indicators was identified. The type of data related to the indicator informed the choice of the data collection tools and analytical approach. In addition, the ease of collecting data for the various indicators was considered to guide the resources allocated to the exercise, while reliability and completeness of the data were considered, full details of the indicators are provided in Annex 1. In summary, three data collection methods were adopted:

4.3.1. Document and literature reviews

For the collection of data that is reliably archived in written form and easily extractable such as innovation financing, policies, guidelines, and laws, a desktop review of the documents obtained either from the relevant offices, organizational websites, or online databases was carried out. This method was also applied for quantitative data on innovation outputs such as publications and patents, and for indicators that have already been gathered and archived by other local and international entities and stakeholders.

4.3.2. Innovation cycle surveys

This approach was used to gather data on the innovation, commercialization, and uptake platforms. The surveys explored institutional structures, processes, and experiences in upscaling and commercializing research outputs and developing intra- and cross-sector linkages. This was sent to the heads of all target institutions by email. To enhance responsiveness, follow-up telephone calls were made to the relevant offices (such as the office of the student registrar). A total of 166 platforms, mapped out in the desktop review, were targeted. The data from the email survey was complemented by detailed interviews in a subset of 30 institutions (Table 1). The questionnaires can be accessed in the annexes presented in the following links: Academia and Research; Industry and Non-Academic Institutions; State agencies

Table 1: Summary of institutions targeted for the innovation value chain survey

TYPE OF INSTITUTION	INNOVATION PIPELINE	NO FOR BROAD-BASED WIDER SURVEY	NO DETAILED INTERVIEWS
Academic and Research Institutions	Knowledge Generation	65	8
Innovation Hubs and Technology transfer units	Commercialization	30	5
Startups	Knowledge commercialization	100	7
Private Institutions and Economic Zones	Market uptake	6	2
NGOs	Awareness and impact	20	3
State Agencies	Governance	15	5
TOTAL		166	30

4.3.3. Case studies of select innovations

The case studies approach was used to facilitate a deep dive analysis into exemplars of innovations in Kenya to further understand the innovation landscape and ecosystem. The case studies allowed the interrogation of selected innovations journey from conceptualization through to commercialization, the inputs, challenges and impact and opportunities for adoption. While we aimed at examining case studies from each domain, we could not secure interviews for some of the domains thus additional case studies were randomly selected while maintaining a set of agreed criteria after consultations from a review expert.

The following criteria were agreed upon and applied:

1. The innovation had a local origin and draws a national interest with its uniqueness, addressing a local societal challenge with the potential of the product/service having a regional and global impact through commercialization.
2. Had substantial technological, social, economic or governance impact at local, regional, or global level, evident in publicly available reports, review of national ST&I and economic reports and the recognition of the innovation through local and global awards.
3. The innovation cases from different regions in Kenya and across sectors highlight the country's development agenda.
4. Allowed a holistic interrogation of the main pillars of the innovation outlook, their relevance, and continuous monitoring

The participation was voluntary, and the information gathered was checked for relevance. About 20 cases were selected but only 10 were considered based on the relevance in addressing all key domains of the KIO.

A case study questionnaire was developed and validated. The analysis of the case studies followed the study framework and mapped the innovation knowledge sources, the scale-up journey, sources of funding and commercialization with a keen interest in the incentives, the impediments, and the supporting policies before examining the impacts. The cases studied included:

- Innovation from the public and private formal academic platforms,
- A private sector lab,
- Energy sector,
- Digitization sector,
- Agriculture and food systems,
- Environmental protection, and
- FinTech sectors.

The list of the case studies and the questionnaire used is attached in the Annex section (Annex 4).

4.4 DATA ANALYSIS AND PRESENTATION

The results are presented in two sections. The first section outlines the status of innovation in Kenya. This section combines descriptive statistics and a summary narrative of the synthesis of the data to provide a general picture of the current state of Kenya's innovation system. In this section, the quantitative data analysis looked at temporal trends, gender disaggregation, and distribution across development sectors and is presented in graphs and tables. For governance structures, policies, guidelines, and laws, the analysis focused on describing the historic development, roles, overlaps, and gaps in roles and jurisdiction, and the data is presented as narratives and in relational maps. For the case study, a thematic analysis of the narratives provided in the focus group discussion was combined with the output from the structured questionnaire and semi-structured interviews to provide a comprehensive description of the innovation's journey through its development pipeline.

The second section presents a scoreboard with a web-based platform. The scoreboard ranks the indicators based on relevance as provided by stakeholders, as well as against other African countries and globally. A digital portal has been developed (http://kio-sti.arin-africa.org/).. The scoreboard is presented using a web-based format to enhance user interaction and utility. It allows the user to select specific indicator comparator countries or periods, and the graphical comparisons. The platform is currently, hosted on the ARIN data centre but will be delivered to KeNIA once fully operational.

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THE KENYA INNOVATION OUTLOOK INDICATORS 2022

5 THE KENYA INNOVATION OUTLOOK INDICATORS 2022

This section presents the outlook in form of indicators developed for each of the domains and sub-domains outlined in the KIO 2022 framework. For each domain/sub-domain, indicators are discussed in terms of their status, trends, challenges and opportunities for learning and improvements as well as potential interventions. The detailed list of indicators and values can be accessed in Annex 1.

5.1 DOMAIN 1: NATIONAL/GLOBAL ECONOMIC AND LEGISLATIVE CONTEXT

The recognition of innovation in national and global economic contexts is critical in legitimizing and allocating resources to the innovation agenda. Out of the five sub-domains under this domain, 18 indicators were identified (Figure 8) with most indicators aligned to the Innovation Governance (n=5). Forty-five (45%) percent of all the indicators in this domain are qualitative while the rest are quantitative. Data could be accessed for about 80% of the indicators even though going forward, information will be required through policy surveys/ interviews.

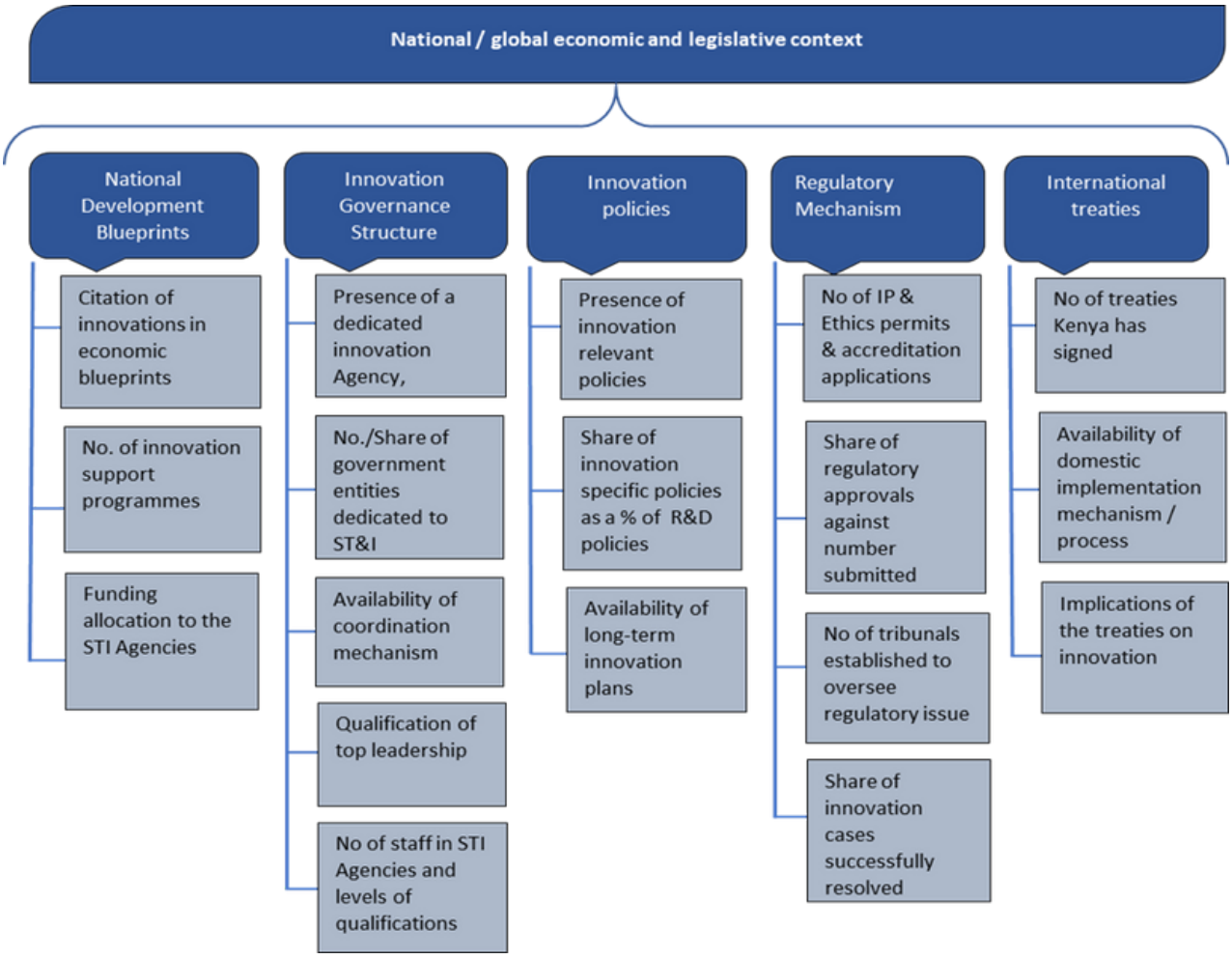

Figure 8: National/Global economic and legislative context Indicators

5.1.1. National Development blueprints

Even though innovation is highlighted in Kenya's Vision 2030 and other blueprints, there is no consolidated visibility of innovation agenda in these blueprints. A National Innovation Masterplan could fill this gap.

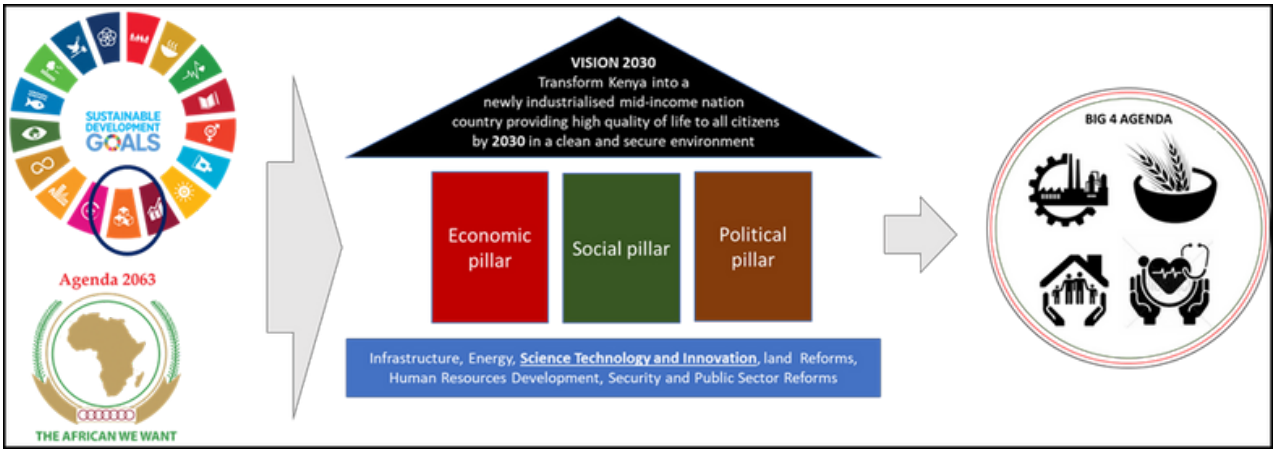

Figure 9: The key economic blueprints documents underpinning the mainstreaming of ST&I in Kenya's development planning

The role of Science Technology and Innovation in the Kenya development plans is anchored in the Vision 2030 and the Big 4 Agenda. In a nutshell, Vision 2030, first mooted in 2008 aims to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by the year 2030 in a clean and secure environment. The achievement of the Vision is predicated on the coalescence of three pillars that focus on economic, social, and political programmes for national development. Science, technology, and innovation is highlighted as one of the foundational enablers underpinning all three pillars. The government of Kenya has built the development ambitions under Vision 2030 and the Big 4 Agendas on innovation for businesses and job creation.

Innovation is cited across the three Vision 2030 pillars and identified as a catalyst for achieving the goals of the pillars. While innovation is not discussed in detail in the Vision 2030 pillars, some elements of innovation such as research, education, and technology development are widely recognized as foundational actions and investment areas to support the Vision. Drawing from the main Vision document, the current government (2013-2022) established the Big Four Agenda focusing on four priority areas for socio-economic growth: universal health care, food security, affordable housing, and manufacturing. The Second Medium Term Plan of Vision 2030, (MTP2, 2013-2017), recommends intensifying the coordination of technology, innovation, research, development, and commercialization for economic growth.

The country has also developed sector specific innovation blueprints. The Ministry of ICT, Innovations, and Youth Affairs has developed a Digital economy blueprint (2019) focused on progressing innovation through harnessing the resources and value addition. The Kenya National ICT masterplan (2013) aims to promote the digital economy for efficient governance, service delivery, and skills development.

Other sectoral blueprints have not been considered in this outlook even though they have some elements of innovation.

In terms of the number of innovation support programmes, the assessment reveals that a very small share of the total programmes in all Government departments i.e., less than 10% of the total programmes on research and development is focused on innovation or its elements. Due to the lack of consolidated innovation agenda, it is a challenge to identify innovation-related programmes. While most programmes, e.g., special entrepreneurship funds (women, youth) have innovation elements such as value addition, innovation is not primarily their agenda. Relatively clearer innovation support programmes are identifiable within the Ministries of Education and ICT, Innovation and Youth Affairs. Under the Ministry of Education, KeNIA for instance has embarked on developing specific support programmes such as the national guidelines on commercialization, aimed at accelerating the commercialization of innovative ideas and establishment of the coordination mechanism for incubation and innovation hubs, which are clear-cut efforts toward facilitating innovations.

The funding allocation for STI Agencies established under the STI 2013 act (NACOSTI, NRF and KeNIA) remains at 2% of the GDP in 2021 and this has been increasing slightly at a rate of 1.3% over the last three years (UNCTAD, 2021). There is other innovation-related funding that goes to other Ministries such as ICT and trade, but it is a challenge to extract what exactly goes to innovation.

Overall, Kenya is making progress in mainstreaming innovation in the development blueprint. The 2021 Global Innovation Index report indicates that Kenya performs above expectation in innovation relative to her income level as a lower-middle class country. The country ranks 9th out of 34 globally, and 3rd out of 27 LMICs in Sub-Saharan Africa.

5.1.2. Innovation Policies

Kenya is making good progress in the innovation policy domain anchored on the ST&I Act of 2013, but most policies and plans are regulatory in nature. More effort is required towards facilitative policies, e.g., commercialization policies and/or strategies.

In the policy sub-domain, three main indicators were identified: the presence of innovation policies more generally, share of innovation-specific policies as a % of all R&D policies and the presence of long-term strategies/plans. These indicators can be broken down further but for the purposes of this study, Kenya has developed more than 10 policies and plans relevant to innovation (Figure 10) in addition to the national blueprints that stipulate innovation as discussed above (please see a detailed policy mapping is provided here.

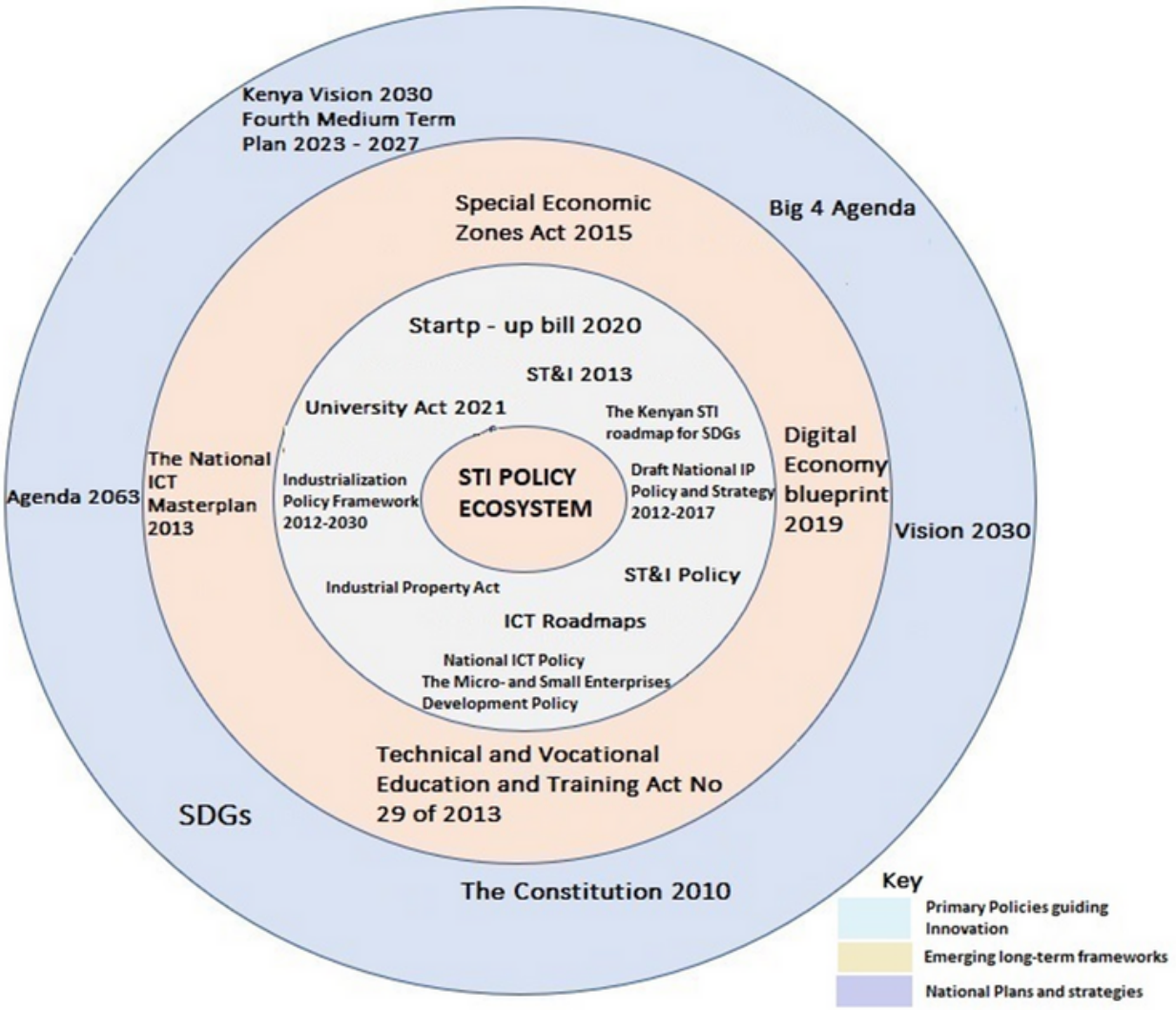

Figure 10: Blueprints laws and policies underpinning innovation in Kenya

The primary document guiding innovation investments in the country is the ST&I Act of 2013. The Act established KENIA, NACOSTI and NRF, and stipulated the entities' mandate for promotion, coordination, regulation, and funding of ST&I respectively. The draft ST&I policy of 2019 provides a framework for coordinating innovation across sectors and Ministries, mainstreaming ST&I into all sectors of the economy and promoting the buy Kenya build Kenya agenda to promote competitiveness and consumption of locally produced goods among others. The policy is premised on increasing R&D to improve efficiency by incentivizing productive sectors and strengthening university, industry, and government linkages for impact.

Other policies, such as the IP draft policy, Start-up Bill and Industrial Property Act, among others, are key in promoting the commercialization of innovative ideas from both formal (e.g., Universities) and informal (e.g., indigenous knowledge) sources. From a long-term perspective, Kenya lacks a consolidated innovation framework to guide innovation activities across sectors. Instead, the existing policies are sector specific. Emerging long-term frameworks such as the Country's Digital Economy Blueprint and the planned National Innovation Master Plan provide opportunities for consolidating the innovation agenda across sectors and accelerate economic growth in Kenya.

Despite the relatively progressive policy outlook, interviews with relevant authorities revealed that weak IP policies are a challenge to innovation in Kenya. The National IP Policy and Strategy of 2012-2017 is still in draft form, with only the establishment of four semi-autonomous institutions for the management and administration of IP. Compared to other African countries, Kenya has submitted a significantly low number of IP policies per capita to WIPO (Figure 11). Part of the challenge relates to the lack of a dedicated agency to operationalize this process or support the overall coordination. These IP policies are also not well mainstreamed in the innovation platforms such as universities and research institutions, most of which, consequently, still lack frameworks to recognize and promote innovations.

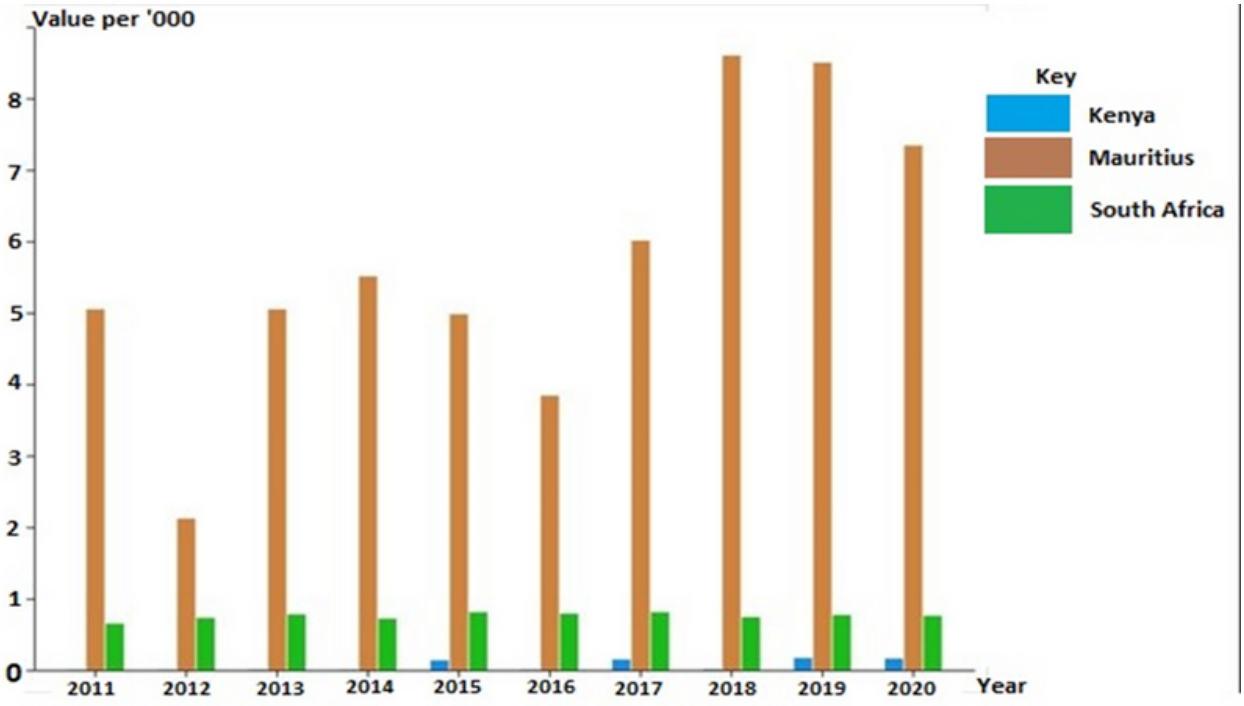

Figure 11: No of IP policies submitted by Kenya compared to the best performing Africa countries in the GII (Mauritius and South Africa) as a share of total population. Source: WIPO, 2021.

5.2 INTERNATIONAL TREATIES AND AGREEMENTS IMPACTING ON THE KENYA INNOVATION SYSTEM

Kenya has signed most international treaties but lacks a framework to evaluate their effectiveness. Three main indicators are prioritised in this sub-domain, i.e., the number of treaties Kenya has signed, availability of domestic implementation mechanisms/process, and the investment value/opportunities of these treaties. In terms of the number of treaties, Kenya is a signatory to various international policies on innovation. Out of a sample of eight (8) key international laws relevant to innovation, Kenya has ratified seven (7) of them (Figure 12). Indicatively, this shows potential alignment to the international policy systems. Some efforts are required to strengthen the domestication of intellectual property policies. Through international frameworks such as the Patent Cooperation Treaty (PCT), Kenya can protect its IPRs and learn best practices from other countries. Kenya is also part of existing assessment frameworks for monitoring and reporting innovations at regional and global levels, e.g., the Africa Outlook, the AU-NEPAD Research and Development Surveys; and the Global Innovation Outlooks (e.g., GII, UN science surveys; the OECD surveys). Despite signing most of the treaties, there is very little information on the effectiveness or impacts of these treaties in Kenyan innovation or wider ST&I pursuit. There is a lack of a framework to evaluate these treaties from a domestic context, i.e., how well they are domesticated, existing structures, and value-addition to the country's innovation outlook.

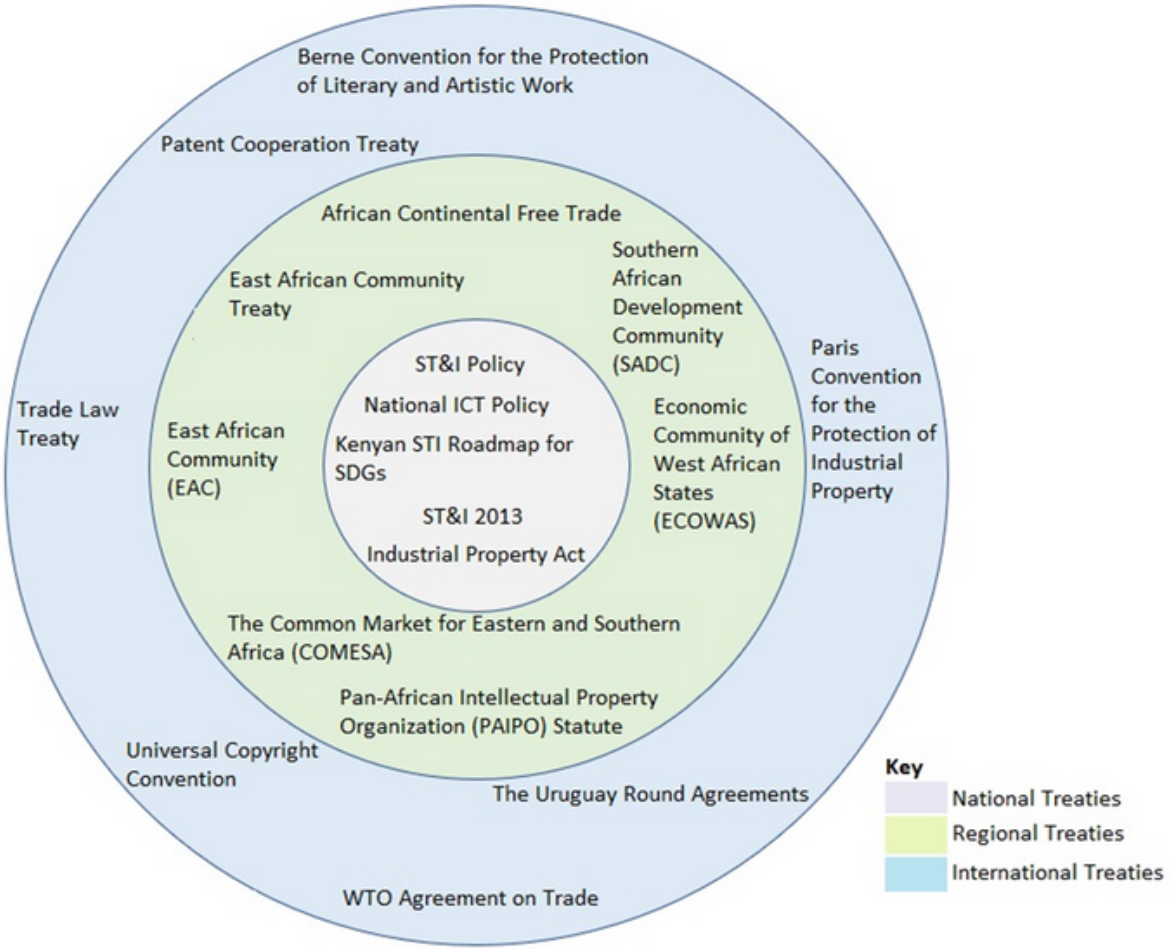

Figure 12: International Innovation Policies and guidelines to which Kenya is a signatory.

5.2.1. Innovation Governance Structure

Kenya's innovation governance structure is concentrated on the regulatory functions and less on the facilitative functions (e.g., marketization, funding etc.). Providing dedicated support to the lead Agency, the Kenya Innovation Agency, could steer facilitate more innovation and less regulatory restrictions.

Innovation governance structures refer to the institutions mandated to oversee innovation in the country. Five indicators were identified as relevant here including: presence of a national dedicated innovation Agency, number/share of government entities dedicated to ST&I, number of staff in innovation Agency, qualification of top leadership, levels of qualification of staff in STI Agencies, and availability of coordination mechanism. Table 2 shows a schematic representation of the State STI governance Agencies and their responsibilities. There are more than twenty (20) other state agencies from across five (5) Ministries playing different roles. The outlook shows that most agencies play regulatory and accreditation roles, but fewer are involved in funding and marketing and promotion.

Table 2: Agencies responsible for governing innovations in Kenya

MINISTRY	REGULATION AND ACCREDITATION	FUNDING	MARKETING AND PROMOTION	INVESTMENT AUTHORITIES
Ministry of Industrialization, Trade and Enterprises Development	Anti-Counterfeiting Agency (ACA)	Kenya Industrial Estate (KIE)	Kenya Export and Promotion Branding Agency	Kenya Industrial Property Institute (KIPPI)
	Kenya Bureau of Statistics (KNBS)	Kenya Development Corporation	Brand Kenya Board	Micro and Small Enterprises and Authority (MSEA)
	Kenya Copyright Body (KeCoBo)		Kenya Investment Authority (KenInvest)	Special Economic Zones Authority
	Kenya Accreditation Service (KENAS)			Export Processing Zones Authority (EPZA)
Ministry of Education	Commission for University Education	National Research Fund (NRF)	Kenya Innovation Agency	
	National Council of Science, Technology, and Innovation			
Ministry of Health	Drug Policy and Planning Centre (DPPC)			
	Poison and Pharmacy Board			
Ministry of ICT, Innovation and Youth Affairs	Communication Authority of Kenya (CAK)			Department of ICT and Innovation and Youth
Ministry of Agriculture, Livestock, Fisheries and Co-operatives	National Environment Management Agency (NEMA)			

The regulatory functions are critical in safeguarding innovations but might not necessarily catalyze innovations and might be restrictive in some instances. Kenya, through the ST&I Act 2013 established a dedicated State Agency, the Kenya National Innovation Agency to promote innovation. The Innovation Agency is a key player in catalyzing innovation and has recently developed programmes for promoting innovation such as the Innovation Bridge Platform, that links innovators to market actors/investors (https://bridge.innovationagency.go.ke/) and the commercialization guidelines under the Research to Commercialisation (R2C) programme (https://academy.innovationagency.go.ke/research-2-commercialization).

This programme is aimed at supporting universities and research institutes to commercialize research outputs. In addition, the longer-term National Innovation Masterplan under draft could enhance synergy in innovation across different sectors. These place KeNIA at a strategic position to catalyze innovations by leveraging on activities of other agencies and ministries such as ICT (currently implementing a digital economy blueprint).

While there is an opportunity to shift efforts from a regulatory governance structure to a more facilitative/catalytic governance structure, the capacity to do so remains weak in most agencies. For instance, a sample survey of the staff outlay in key ST&I agencies, e.g., NACOSTI, NRF, and KeNIA showed inadequate staffing often struggling to achieve the stipulated mandates. The leadership skills for these agencies also matter. An entrepreneurial, partnership, fundraising and analytical skillset as well as relevant academic qualification, e.g., PhD, are pre-requisite for steering transformative interventions and governance shifts. But even with qualified leadership, availability of enough and qualified staff and team members remains key. For details on innovation governance structures and a description of the various Agencies and Ministries please see Annex 5.

In terms of coordination and synergies, the country currently lacks a clear mechanism for coordinating the innovation agenda of various ministries and their respective agencies. Rather, there are ad-hoc meetings and engagements across various forums such as the Kenya Innovation Week and other set-ups by the private sector or other players. This has reduced the opportunities to develop synergies and create inter-ministerial partnerships to catalyze innovation and minimize conflicts. Multiple agencies working in silos also result in confusing information regarding critical innovations in the country.

Globally, Kenya ranks position 80 on institutions and 92 on regulatory quality, measured in terms of perceptions of the quality of services stimulated by public policies, perception of policy stability, e.g., from political pressures, and the quality of policy formulation and implementation as well as Government's commitments (GII, 2021). This is an average performance, relatively distant from the leading African country (Mauritius) ranked at position 21 on institutions. Even though the country is making good progress in institutional development, some of the challenges highlighted above are important.

Reflecting on best governance practices elsewhere, Kenya has an opportunity to learn from Mauritius which leads Africa's innovation landscape on indicators such as institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge, and technology outputs (GII 2021). Mauritius has specifically strengthened its facilitative governance model through strategic stakeholder partnerships including PPPs that have grown its innovation and technology sector. The Mauritius Research and Innovation Council (MRIC) recently signed an MoU with the UNDP to enable sharing of data on the innovation ecosystem in Mauritius and to facilitate joint research, multi-stakeholder experiments, and programmes.

5.2.2 Regulatory and accreditation mechanism

This sub-domain overlaps with the governance sub-domain but is mainly focused on enforcement. Three main indicators are prioritized here - availability of dedicated enforcement agencies, share of successful legal cases on innovation, availability of tribunals established to oversee innovation and property rights, and share of patent approvals against the number submitted. Kenya has dedicated agencies to protect innovations through intellectual property rights and patents. The Kenya Copyright Board (KECOBO) is a State Corporation under the Office of the Attorney General & the Department of Justice, established by section 3 of the Copyright Act 2001 and administers and enforces copyright and related rights thus protecting innovation ideas from piracy and counterfeits. Additionally, the Kenya Industrial Property Institute (KIPI) was established in 2002 under the Ministry of Industry, Trade and Cooperatives to administer Industrial Property Rights, and to provide technological information to the public.

In terms of patents registered and defended, about 38% of patents submitted, were registered with KIPI between 2016 and 2019 with only 8% of these being approved (KIPI, 2019). During the stakeholder interviews, there were concerns, especially from universities, that the patenting and regulation for research is weak, with instances where patents have been lost under unclear circumstances. Key challenges to IP enforcement, as identified by stakeholders, include a lack of prompt responses to queries, and long patent registration time coupled with the fact that some applicants are not familiar with the registration requirements and the documentation. At the same time, the high turnover of patent examiners impedes adequate and informative consultations between patent applicants and examiners. Some applicants resort to withdrawing their patent applications, subsequently resulting in very low numbers of patent applications in the country over the years. This lack of enforcement has created volumes of counterfeit products in the Kenyan markets. The low numbers have also been attributed to the lack of promotion of innovation-centric education in higher learning institutions while increased counterfeit is because of a lack of enforcement of standards.

5.3 DOMAIN 2: INNOVATION LIFE CYCLE/VALUE CHAIN

The sub-domains under this value chain include Ideation, Product development/commercialization and diffusion/uptake. A total of 58 indicators were identified (Figure 13) out of which 28 were prioritized by stakeholders as most relevant while the rest were ranked as "low/not relevant". The commercialization domain had the highest number of indicators prioritized and highly ranked by stakeholders as relevant and was also identified as a key area of innovation support. Approximately fifty-four percent (54%) of all the indicators in this domain are qualitative in nature while the rest are quantitative. Data could be accessed for about 85% of the indicators through desktop analysis and rapid interviews. There is an opportunity to obtain missing data through in-depth sectoral analysis and interviews executed within an allowable timeframe.

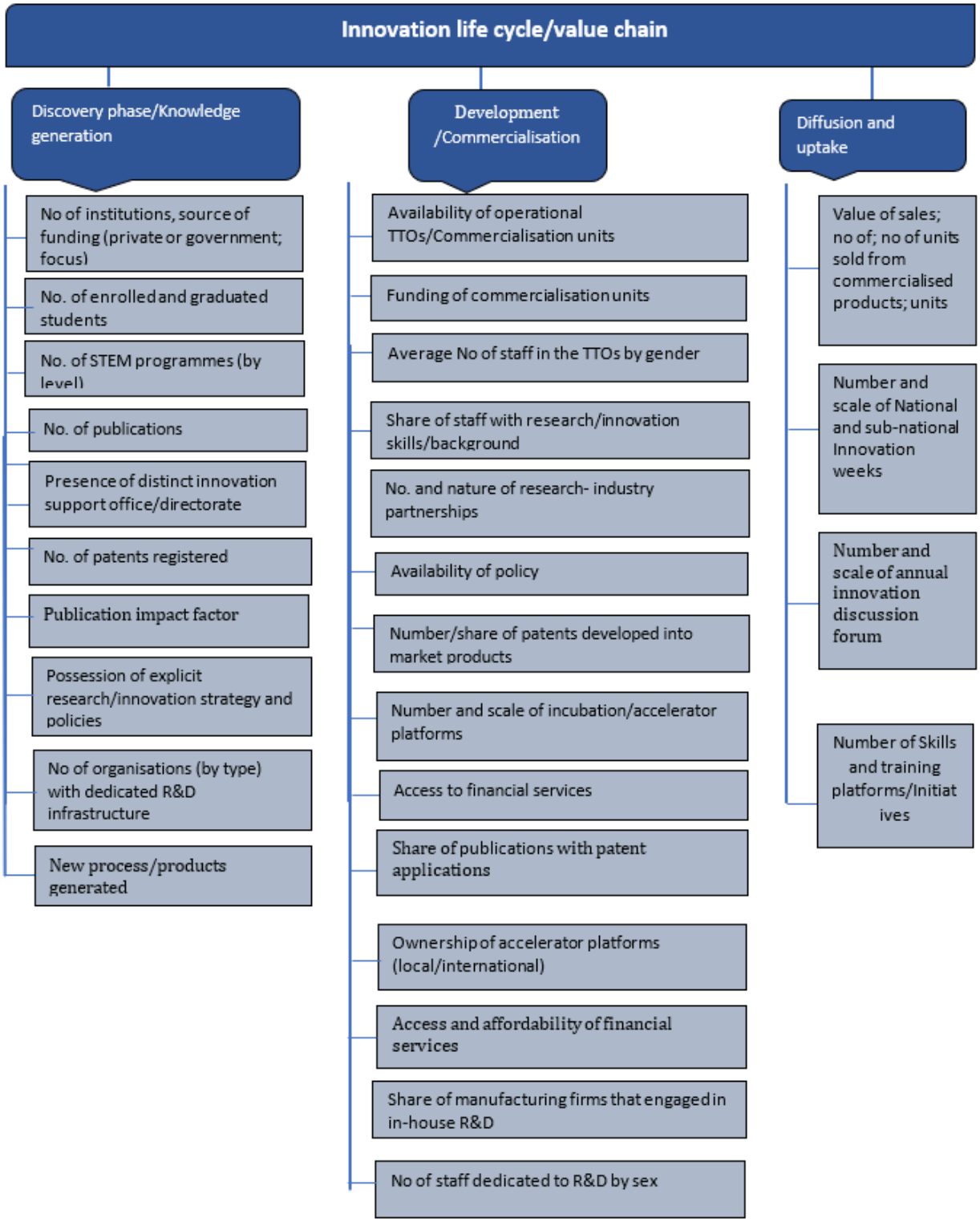

Figure 13: Innovation life cycle/value chain indicators

5.3.1. Discovery phase/Knowledge generation

Kenya's knowledge-producing platforms are increasing in number, but the number of innovation-relevant knowledge is still very minimal thus need for innovation-specific courses and academies to strengthen the production of innovation-relevant knowledge.

5.3.1.1 Academic Platforms

As of 2021, there are a total of 21 research institutions in Kenya out of which 11 are public and 10 are private. The number of universities and TVETS has been increasing in the past decade as shown in Table 4. The number of universities increased from 66 to 74 between 2015 and 2020, an increase of 12.12 % in five years. Similarly, the number of Technical Vocational Education and Training institutions in the country rose significantly by 87% from 874 to 2,191 between the years 2015 and 2020 (Figure 14). By design, the increase in numbers of TVETs signals opportunities for more technical skills to transform ideas into practical initiatives. The Government has made deliberate investments in the establishment of TVETS, recognizing their role in driving practical innovations for economic growth and employment for the increasing number of youths. Despite the Government's efforts to increase support, of these TVETS face some challenges especially inadequate funding 2017; Akala & Changilwa, 2018. In other words, investments in TVETS are more focused on their establishment but less on their operations thus challenging the overall objective around practical skill development and job creation

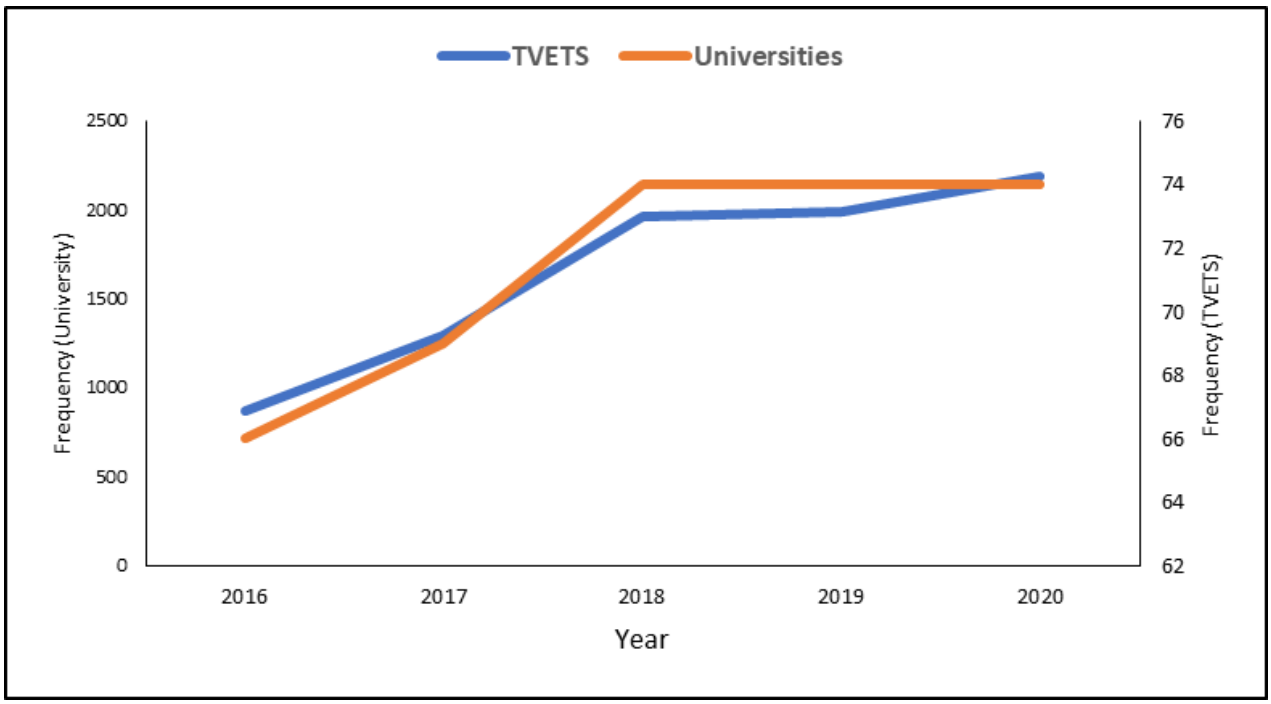

Figure 14: Number of universities and TVETs in Kenya between 2015 -2020

The expansion of TVETS and Universities has resulted in a significant increase in student enrolments. Between the years 2015 and 2020, the TVET subsector recorded a significant increase in enrolment of approximately 70% from a total of 142,410 in 2015 to 430,598 students in 2020 (Figure 15). The upsurge in TVET enrolment over the years is occasioned by the Government's deliberate effort to sensitize students on the relevance and benefits of TVETS accompanied by tailored incentives such as special funds, e.g., the Youth Fund. The enrolment in the university however recorded a 7% increase between 2015 and 2021 (KNBS, 2020). The relatively small increase in enrolment rates can be attributed to the decrease of self-sponsored students, the availability of alternatives such as TVETS, the COVID-19 pandemic, and the ongoing reforms in the education sector.

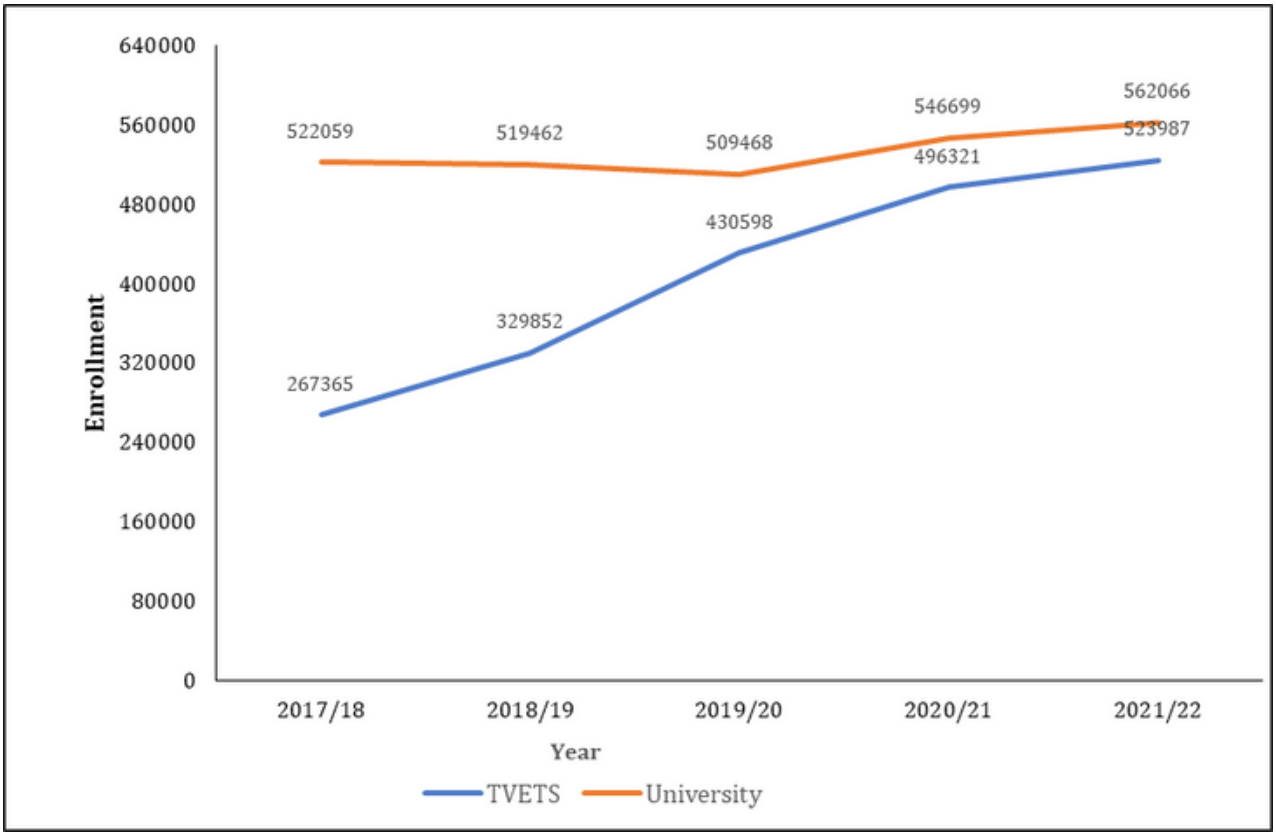

Figure 15: Trends in enrolment in the Kenyan Universities and TVETS from the year 2015-2020.
Source: Commission for University Education, 2020 / KNBS Economic Survey, 2020

In terms of the subject area, only 16% of students graduated from STEM subjects between 2016 - 2021 indicating that there is a need to support more enrolment of both males and females in STEM courses even though this is expected to increase in 2022. Out of this, only 30% were female, signaling a gender imbalance that needs to be addressed. In terms of research, Kenya has 225 full-time researchers per million inhabitants. This figure, although impressive amongst Kenya's EAC peers (e.g., Tanzania has 26.5 researchers per million inhabitants) is still dismal by global standards in innovation related R & D. There is need for more researchers who would dedicate their time and expertise in strengthening the governance structure in the innovation sector.

There has been a modest increase in research activities and associated outputs. According to the economic survey of 2021, doctoral and postdoctoral researchers that were granted research licenses were 781 in 2016/2017 1,129 in 2018/2019, and 1,046 in 2019/2020 (Kenya National Bureau of Statistics, 2021). In terms of research, there was a slight decrease in the number of research licenses granted to individuals and institutions from 2017-2020. The number of research license applications to NACOSTI declined by 1.5% from 6077 in 2019/20 to 5,985 in 2020/21, while the total number of licenses granted decreased from 6,112 in 2019/20 to 5,153 in 2020/21 (KNBS, 2022). This could be attributable to the COVID-19 pandemic that affected businesses, and academic and research institutions that had to adhere to the containment measures.

The number of funds disbursed for the successful research funding applications was Kshs 59.9 million in 2019/20 while the number of applications for multidisciplinary research funding was 811 of which only 58 were successful. In 2019/20, the number of funds disbursed for the successful multidisciplinary research funding applications stood at Kshs 506.73 million. Based on the surveys and stakeholder engagements, the performance in knowledge generation is highly hinged on funding. Measured as Investments in the Research and Development (R&D), Kenya invests 0.7% of GDP in R & D and this is relatively lower than the global average of 2.63% and the aspirations of the STISA 2024 on 1% GERD. Narrowing down to the expenditure on education the percentage of GDP expenditure on higher education slightly increased by 0.1% and currently stands at 5.3%.

In comparison to other countries in Africa and the world, the % of GDP expenditure on education is slightly higher than that of Mauritius and relatively lower than the South African value (Figure 16). The allocation spent on research and development is also lower than the UK but slightly higher than the Mauritius allocation and at per with the South Africa allocation. Kenya also needs to enhance the university-industry linkages to promote innovation uptake and commercialization. The Country's enrolment in tertiary institutions is relatively lower compared to the regional and global giants and thus needs improvements. The human capital is also low thus corresponding to the lower enrolment rates and the poor university-industry linkages. Overall, Kenya has a chance to improve on the knowledge platforms to improve performance through enhancing innovation-oriented training/skill development and courses which are currently weak in universities, research organizations, and TVETS.

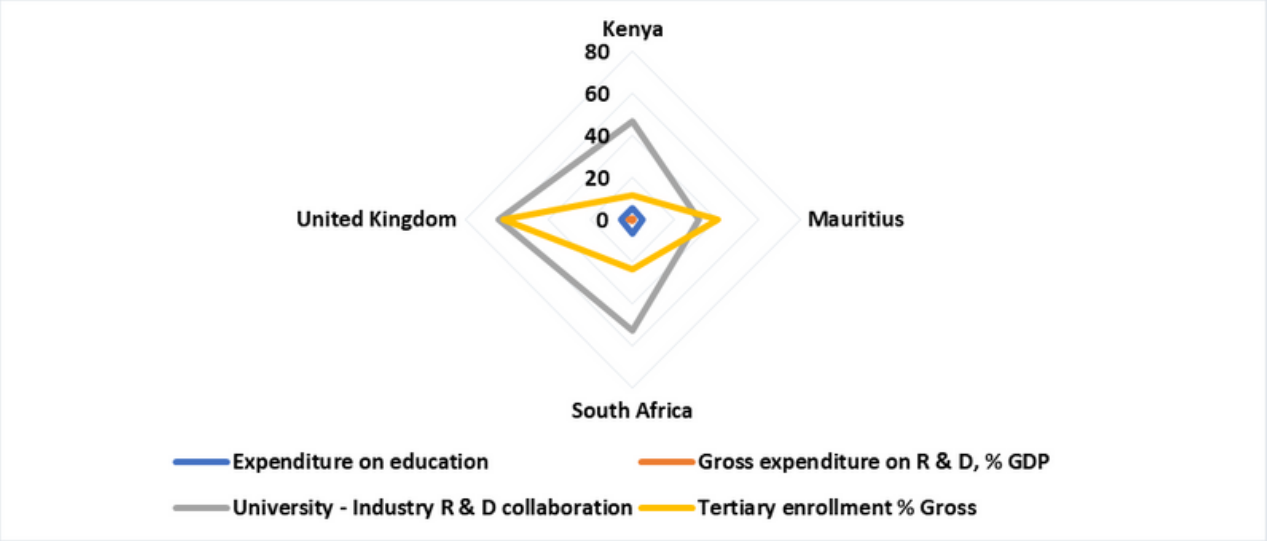

Figure 16: Knowledge platforms metrics for Kenya against the Global and regional best-performing countries

5.3.1.2 Non-Academic platforms

Non-Academic Platforms are knowledge-generating sources outside Universities/TVETS and research institutions including private firms and CSOs. Some of the identified indicators here include the number of NGOs involved in knowledge and innovation-led activities; the percentage of manufacturing firms with a focus on R&D; Private R&D firms; State-funded R&D entities; University-Industry collaboration among others. Kenya is making progress in the area as the number of firms embracing R&D through strategic collaborations is increasing. The latest data from the Second National Innovation Indicators Survey 2015, indicate that the % of manufacturing firms in 2014 that cooperated with universities or other higher education institutions was about 61 firms out of 100. Kenya ranked No. 1 in 2014 in Africa.

The analysis above gives an overview of knowledge producing platforms from both academic and non-academic sources. The analysis is relatively biased towards the Universities and TVETS with little in-depth focus on other research institutions that also produce knowledge e.g., National, and international research organizations that play a key role in the country's knowledge systems. Despite this limitation, the overall trend indicates that the country is experiencing an increase in knowledge producing platforms and outputs both in terms of graduates and publications. As part of the innovation value chain/life cycle, the next step is to transform these ideas into marketable products through a commercialization/development process as outlined in the next section.

5.3.2. Knowledge Development /Commercialisation

Commercialization is a key part of innovation outlook. Platforms for commercializing knowledge products are becoming prominent but are small-scale, uncoordinated, and not properly linked to the knowledge producing platforms.

From the stakeholder and expert inputs, the commercialization subdomain is critical for the country's innovation aspirations. Commercialization is key in turning the increasing number of knowledge products into marketable products, industrialization, and ultimate job creation and economic growth. A total of 21 indicators were identified with 14 out of these being prioritized. Some of the main indicators here include the number, distribution, and funding of innovation start-ups; the existence and functionality of technology transfer units (TTUs) or innovation commercialization units in academic platforms, and the patenting processes.

Even though the commercialization rate of innovations is still low in Kenya, the number of platforms aiming to commercialize innovations has generally increased in the recent decade. The proliferation of innovation hubs and technological advances in Kenya has led to increased interest in converting ideas into resource streams through commercialization.

The establishment of technology transfer offices (TTUs) in the universities and research centres has received policy attention in the recent past as a way of catalyzing research commercialization. Despite such efforts, survey results show that most TTUs lack adequate capacity including staff and funding to effectively commercialize research products/ideas. In most universities for instance, researchers are not aware of the existence of TTUs or their functions- i.e., the connection between the TTUs and researchers are very weak. This is further complicated by weak IP policies that are yet to be well mainstreamed in the innovation platforms such as Universities and Research Institutions. For instance, academic and research institutions still lack adequate capacity to draft patent applications for their innovations and successfully commercialize their innovations. Consequently, the number of patents and successfully commercialized innovations by academic institutions is still low. There is a need for a clear innovation commercialization framework/guideline that Universities and research institutions can adopt.

Figure 17: Number of patents from Kenya between 2010-2020

The development and commercialization of innovation ideas/knowledge in Kenya are further supported by the numerous start-ups, incubation, and hubs. Start-ups in Kenya are increasing rapidly due to enabling business environments such as the ease of starting a business. Kenya has also experienced growing access to start-up funding (e.g., specialized enterprise funds) from domestic and international sources (e.g., the World Bank, FDI especially from development partners such as the United Kingdom). The Kenyan government has been strengthening the start-up ecosystem through targeted investments in enabling platforms. The Association of Start-up and SMEs Enablers of Kenya (ASSEK) has brought together and represents the interests of organizations supporting the development and growth of start-ups and SMEs for maximum impact. Analysis of start-ups shows major regional imbalances in the numbers of start-ups. Out of a sample of 34 start-ups, about 70% are based in Nairobi city and this is a major challenge in promoting innovation and technology across the country. Further review of the overall distribution of startups across the country as shown in Figure 18 show that Nairobi is leading in the number of startups followed by Mombasa, Uasin Gishu and Kisumu. This is mainly attributed to Nairobi being a hotspot for financial success and having a conducive enabling environment to support startups through platforms like Nairobi Innovation Week. However, Wajir, Bomet and Kajiado record the least number of startups due to the lack of sufficient innovation forums/ platforms and low knowledge generation platforms in these areas.

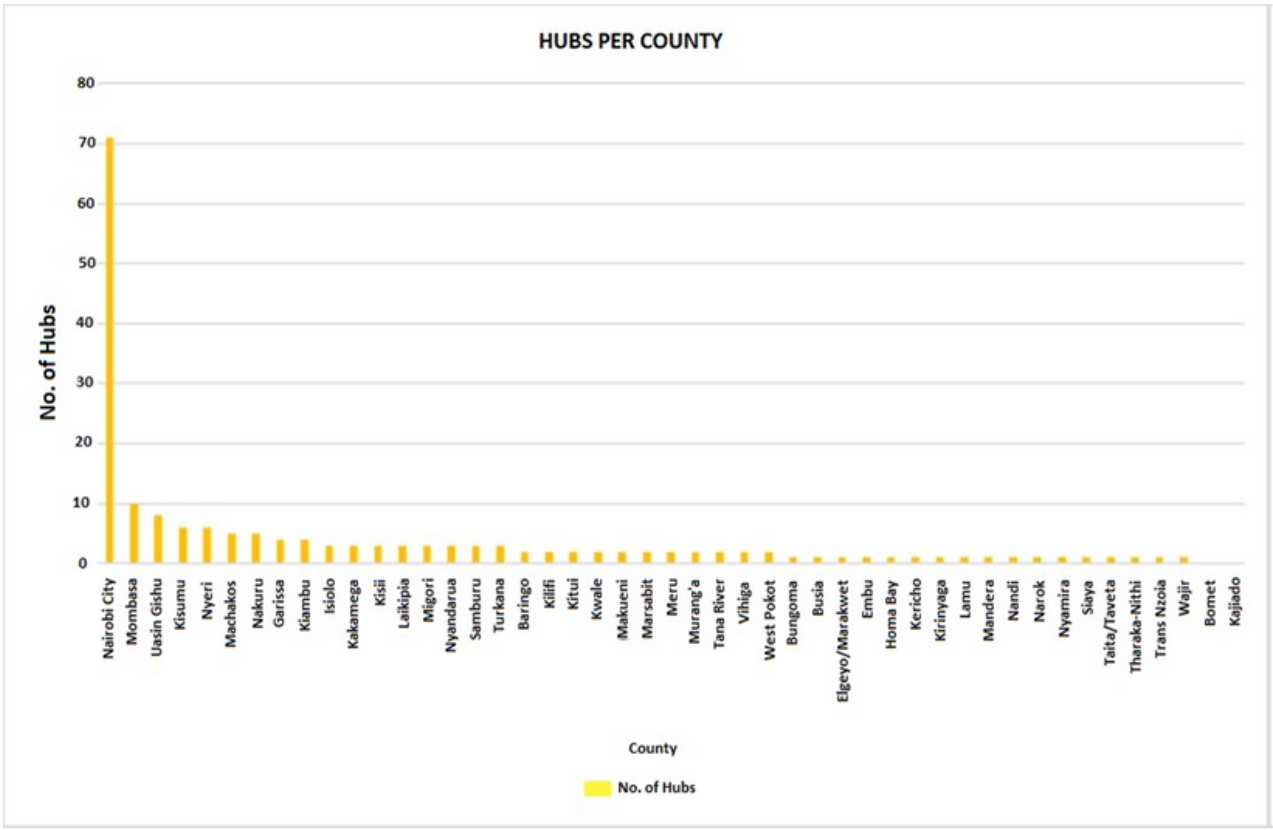

Figure 18: Start-up distribution in Kenya

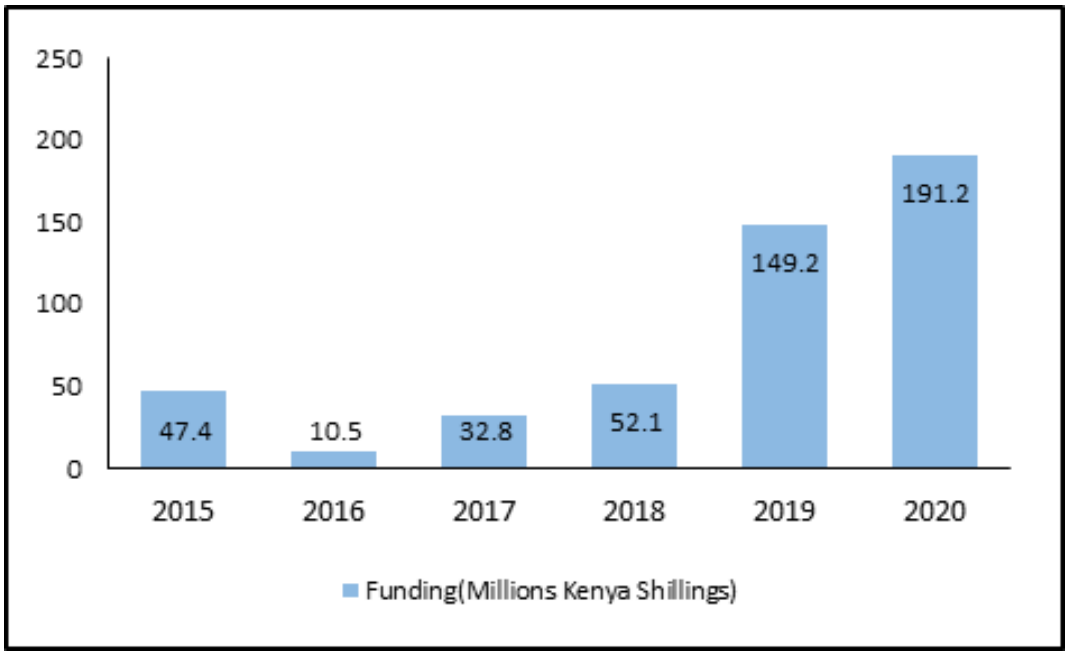

Figure 19: Total start-up funding in Kenya by year (2015-2020)

From the sample, 98% of the start-ups have access to some form of funding even if inadequate. Funding for start-ups has been increasing, over the last five years (5) even though average funding per- start-up remains low. The main sources of funding include Government, internal seed funds, GIZ, USAID, the World Bank and Bilateral development funds through FDI. Despite the funding, most start-ups i.e., about 73% fail to reach their maturity due to lack of adequate funding and technological advice. The current start-up bill might be useful to address these concerns by facilitating linkages and partnerships for scaling up start-ups. There are also concerted efforts through the Kenya Innovation Agency (KeNIA) with the support of FCDO to establish Innovation Bridge Platform https://bridge.innovationagency.go.ke/ where innovations can be identified and linked to the market processes. Such platforms have the potential to protect and nurture start-ups to maturity.

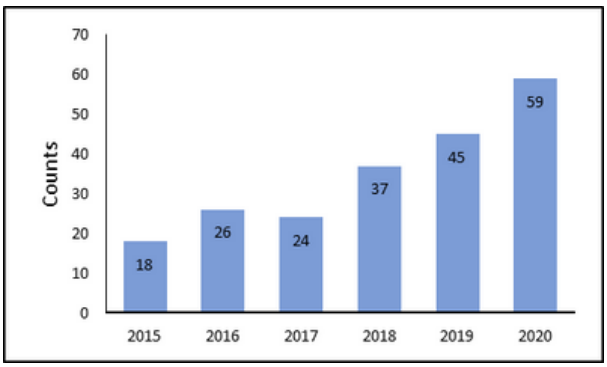

Figure 20: Number of funded Kenyan start-ups per year from 2015-2020.
Source: The African Tech Start-ups Funding Report 2020

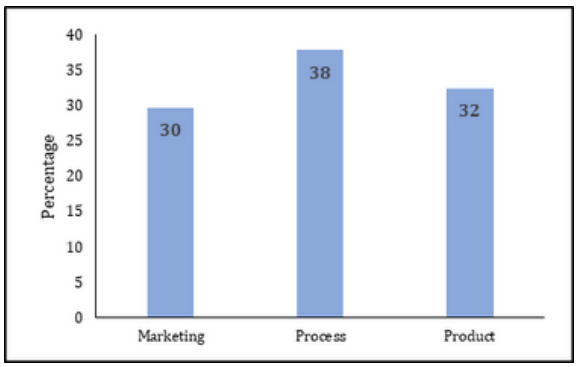

Figure 21: Typology of Innovations in various start-ups operating in Kenya

In terms of typology of innovations being pursued, most start-ups are engaged in process innovations (41%) owing due to a conducive technological environment in Kenya while 36% and 23% are focused on product and marketing innovations, respectively. Most of the start-ups are owned by males 76% while 24% are female-owned. This gender bias in ownership reflects some of the social and cultural barriers that impede innovations as described in section 4.6.

Innovation hubs also play a role in the ecosystem and it's worth noting that innovation hubs ecosystem has been rapidly growing in Kenya, since the establishment of the hub in Nairobi in 2010. The ihub is primarily dedicated to accelerating the application of social capital and technology for economic prosperity and supports startups as instruments of fostering innovation and economic growth in tackling poverty.

According to the 2020 Kenya National Bureau of Statistics survey report, efficient transport, infrastructure, and access to business licence simplify the conduct of businesses. However, innovation hubs still lack established structures to assist young people in exploiting their full entrepreneurial potential and tapping into their technical and business skills. This is evidenced by the lack of incubator centres and common facility centres that enable research and innovation to commercialization.

The academic and industry linkage has been a key part of commercialization. However, this relationship has been deteriorating in the recent past. Currently, it stands at 46.8% of the universities linking to the industries from 55.1% in 2019. Additionally, the linkage between the start-ups/incubators and the university/Research Institutions is relatively weak or unclear. There were no clear channels of communication and linkages between universities and existing start-ups and incubators. This signals a major gap in the innovation process where weak university-Industry linkages limit the contribution of these universities to the innovation impacts. About 73% of the start-ups mapped do not have access to innovation and technological advice. For instance, while information on IP policy and commercialization is key for start-ups, there is no mechanism through which most start-ups receive this information.
A ranking by WEF-GII, indicated that Kenya was no. 32 out of 137 in 2017.

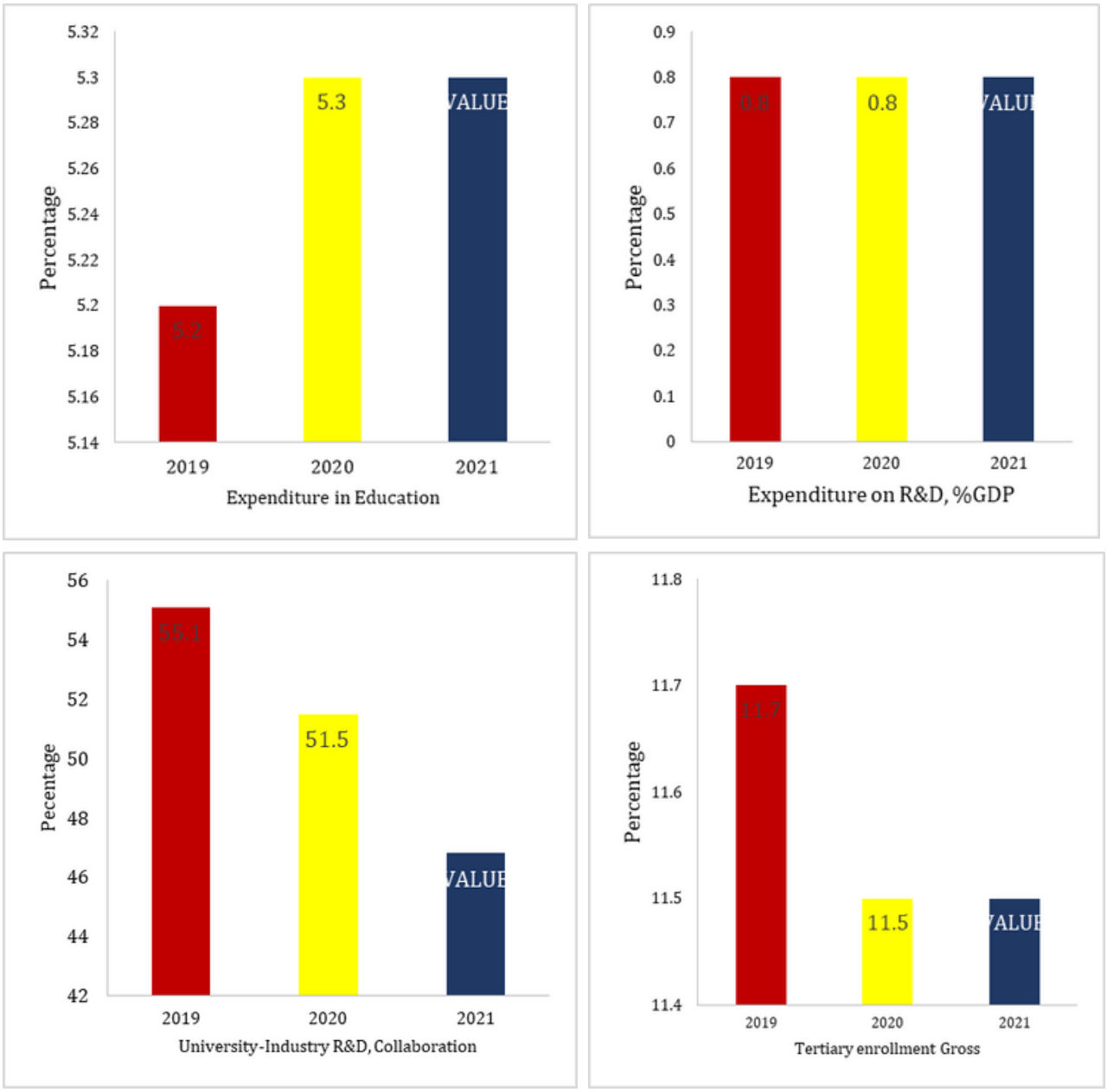

Figure 22: Knowledge Platforms metrics performance trend for Kenya

5.3.3. Diffusion and uptake

Kenya has a number of platforms that support innovation diffusion /uptake through awareness creation but still needs initiatives that promote investments as part of diffusion/uptake through market and product expansion.

The country has various innovation forums that are key in creating awareness about innovations and disseminating new innovative ideas. Innovation is widely dependent on uptake opportunities that usher the resulting products into the market. Innovation weeks have become a key platform for diffusion innovations. The Kenya Innovation Week (KIW) for instance brings together innovators and enterprises from across the country to showcase their innovations and during the sessions, the best innovations are recognized and awarded. In 2019, KeNIA awarded twenty-five (25) innovators cash prices while twelve (12) innovators were provided with grants to enable them to commercialize their products and services. In efforts to support social inclusion, recently the assistive innovation category was launched to include people living with disability and the elderly.

There are also County Innovation Weeks e.g., the Pwani Innovation week among others. Specific focus is given to the operations of these platforms, when they were established, how often they happen, the key players, the key stakeholders targeted, the status of these platforms, the existing incentives used for upscaling, funding sources, the specific activities of the platforms, outcomes, and impacts, how this impact are monitored and existing gaps. Scaling up and uptake of innovation is receiving keen attention in Kenya as the country seeks to fast-track its Vision 2030 through targeted agendas such as the Big 4 Agenda. Kenya has embraced several fora and market opportunities to create awareness and scale up innovation.

The universities are also convening Innovation weeks e.g., the just concluded Nairobi University Innovation week; the Eldoret University week among others. In 2019, the Nairobi innovation week of June 10th-14th focused on building capacity, a core in forming a movement comprising over 30 start-up enablers. In 2020, Konza Metropolis Innovation Program convened a session that attracted entrepreneurs, policymakers, innovators, development agencies, government officials, and other ecosystem players. A total of 1000 youths were empowered. A series of symposiums and dialogues also formed a strategic opportunity to link innovators to potential donors to fund their research. For example, through the Kenya Innovation Forum, Leaders in Innovation Fellowships are linked with new researchers to establish collaborations. Besides, the innovators are encouraged to register and participate in a grant program to build and deliver high-impact, collaborative projects, or activities. The forum supports and accelerates innovations and entrepreneurship at all levels.

At the regional level, efforts by EASTECO and ASARECA in championing innovation are evident. ASARECA has been vital in disseminating agriculture in the region with Kenya being a beneficiary. Through the ASARECA research network, adoption, and dissemination of the research approaches among the members' organizations has improved technology uptake and upscaling. There are also several digital platforms for interactions between innovators and market players. With the support from FCDO, KeNIA is working with partners to develop an Innovation Bridge platform aimed at exposing prototypes in Kenya in a virtual marketplace where they can be linked to investments/partnerships for commercialization and contribute to job creation and overall economic growth of Kenya.

5.4 DOMAIN 3: INPUTS/INVESTMENTS

Investments are a critical driver of innovations. The investments domain constitutes two sub-domains: funding and infrastructure. Under this domain, 14 indicators were identified and prioritized by stakeholders. The funding sub-domain was prioritized as a critical sub-domain and as a critical enabler of innovation actions across all domains. Four (4) of the indicators prioritized are qualitative in nature while 10 are quantitative. Data challenges were mainly experienced in share of funding from non-state actors.

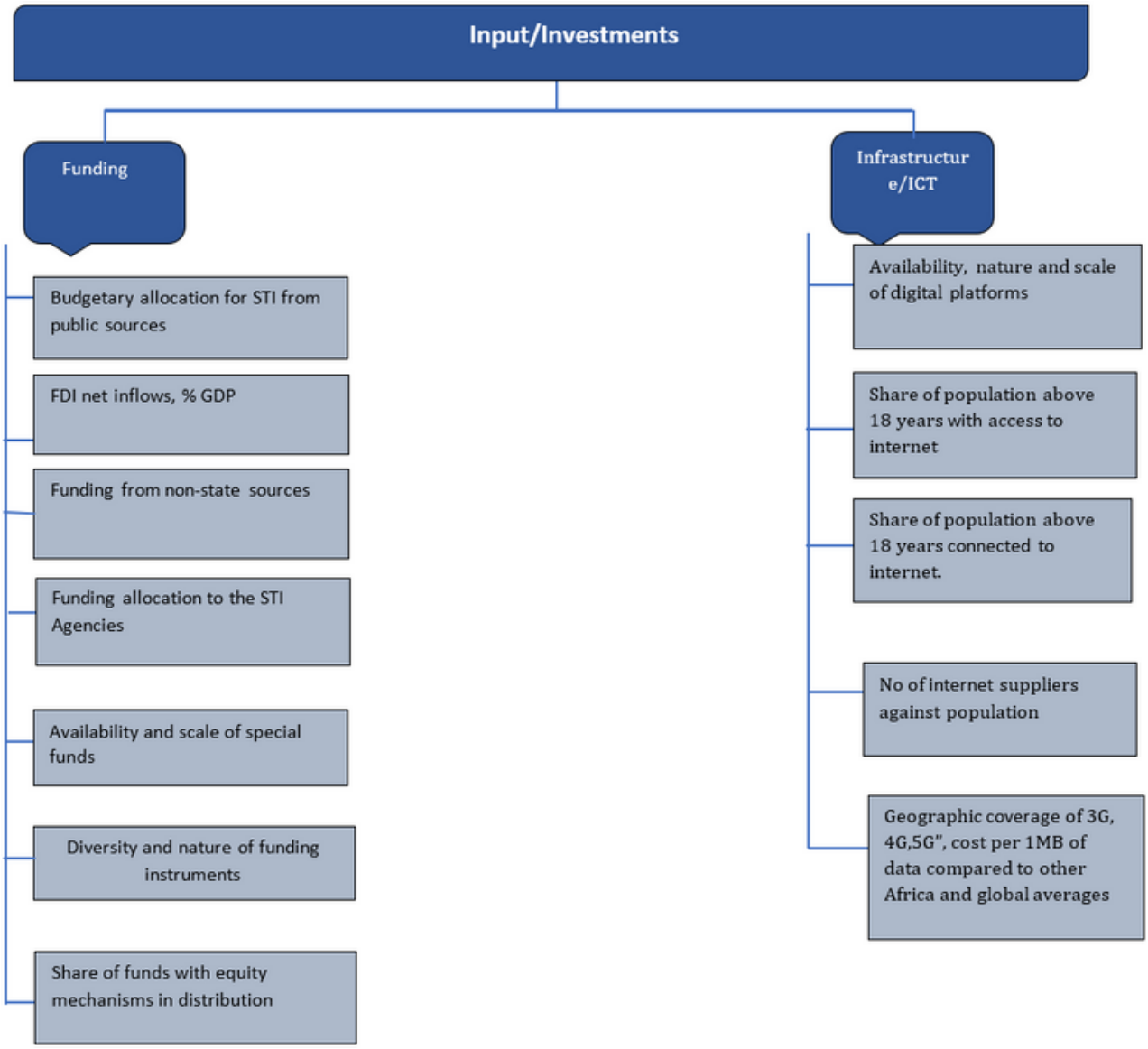

Figure 23: Investments domain, sub domains and Indicators

5.4.1 Funding

The National Budgetary Allocation to ST&I is inadequate. Nevertheless, Kenya enjoys more inward Foreign Direct Investment (FDI) in Africa.

Funding remains a major factor in the innovation cycle. Kenya draws ST&I funding from a variety of sources - financed by the public sector, international donors, development, banks, or the private sector. These are discussed below.

a) National budgetary allocation

The National budgetary allocation to ST&I remains low with a Gross expenditure on research and development rate of 0.8% since 2019, relatively lower than the global average of 2.63 and the aspirations of the STISA 2024 of 2%. Other than the national allocation, special funds exist such as the women and youth enterprise funds targeting entrepreneurship development and innovation. The funds target to support innovative and promising business ideas. Over the last three years, the Government disbursed sh600 million to sh800 million to enterprises even though it's unclear the extent to which these funds mainstream innovations in their operations. A tailored guideline is required to enable these funds to assess, identify and mainstream innovations targeted to particular social groups as well as their alignment to the country's innovation niches and opportunities. Private sector funding of R&D is gaining critical consideration in Kenya's ST&I funding. This is however hampered by the weak connection between University-Industry linkages and weak commercialization infrastructure. There is no consolidated framework to assess the amount of private sector and CSO funding for ST&I and this is partly due to the missing coordination mechanism, highlighted in section 4.2.4 (Innovation governance). Consequently, data for this indicator is scarce and largely unavailable.

b) Foreign Direct Investments

Kenya continues to be a priority country in international investments in ST&I given its long-term collaborative relationships and enabling environment for international business. There is increasing foreign investments and funding of innovations especially through innovation hubs and start-ups in Kenya. According to UNCTAD (2020), FDI stood at USD 1.3 billion in 2019 with the ICT sector attracting the lion's share of that. Alongside South Africa, Ethiopia, Uganda, Nigeria and Rwanda, Kenya has benefitted from USD 10 billion in funding from international sources that have been directed to the ST&I sector in the last five years. The main contributors to this funding portal are the FAO, AFD, NORAD, and UK FCDO. Kenya received 23% of the USD 10 billion portfolio, the second highest after Ethiopia.

The country also attracts additional international funding especially from multilateral sources such as the World Bank as part of FDI. These funds are largely disbursed as a mix of instruments including debts, grants, new operation facilities such as green fields and blended financing. However, the instruments used to disburse these funds are shifting fast. For example, FDI in form of cash flow decreased from $1139 million in 2018 to $1098milllion in 2019 while greenfield investments rose from 65 in 2018 to 95 in 2019 . Service-based sectors remain the major focus for investors. This requires Kenya to identify innovations that not only support national economic growth but also align with the new global funding requirements. For instance, the new UK spending strategy prioritizes enhanced trade rather than Aid as a way of funding ST&I. The shift from Aid to trade is an opportunity for Kenya whose business environment is ranked as globally competitive.

[4] https://www.lloydsbanktrade.com/en/market-potential/kenya/investment

c) Equity funding

Kenya is one of the largest recipients of annual equity funding in Africa for tech start-ups such as Tala initiative that embrace mobile loans for greater financial inclusion. In 2018, Kenya was among the nine African countries, which received more than $10 million in annual equity funding from FDI for tech start-ups. The M-Pesa revolution, government investments in Konza City, and the launch of innovation labs in the country have made Kenya the technology hub of Africa. This niche market is estimated to be worth $ 1 billion by 2019. This revolution has also brought about an increased flow of venture capitalist (VC) funding to the region. Kenya accounted for 76% of $ 121.9 million invested in East African start-ups in 2016, of this amount.

d) Capital and credits

While we note an increased flow of VC, the country lacks clear investment policy frameworks through which venture capital could provide seed money for innovation. There is no explicit mention or recognition of venture capital firms as legal entities equity (Divakaran et al., 2018). Policymakers should consider re-orienting financial institutions to focus their efforts on providing credit for venture capital funds and financing collaboration between PRCs, universities, the productive sector and industry. For example, the provision of incentives to firms to substitute one form of investment (e.g., access to loans) for another could support more innovations in firms. The business environment is also conducive for innovations to thrive. This includes the time required to start a business which is favourable and the ease of access to loans and the attitude towards entrepreneurial risk.

5.4.2 Infrastructure

Kenya is investing in infrastructure as an enabler of innovation but there is need to facilitate the utilization of this infrastructure across sectors.

a) Digitization

Kenya's digitization blueprint targets to achieve three elements relevant to Kenya's economic transformation 1) enhanced good governance, where digitization is expected to enhance government efficiency, improve accountability and enhance revenue collection; 2) transforming human capital through path breaking technological innovations, enhanced capabilities on data, digital skills and platforms; and 3) creating favourable business climate for innovation to thrive. While the digital economy blueprint is hinged on digitalization across government, business, and infrastructure to achieve the three outcomes, the focus is more on digital skills 'in professionals and lacks a strategy to support general public participation. However, through the Ministry of ICT, the National ICT and Innovation Policy bridge this gap by focusing on four areas: prioritizing mobile access; expansion of the digital economy, skills and innovation for research, technology products and industries and government. The National ICT policy has recently in 2020 developed a number of guidelines. The guidelines have facilitated the formation of the infrastructure that enables the use of high speed, wireless and internet, across the country. The guidelines have further supported infrastructure and frameworks for the growth of data centres and the pervasive Internet of Things technologies, machine learning and local manufacturing. This has positioned the country to embrace emerging trends.

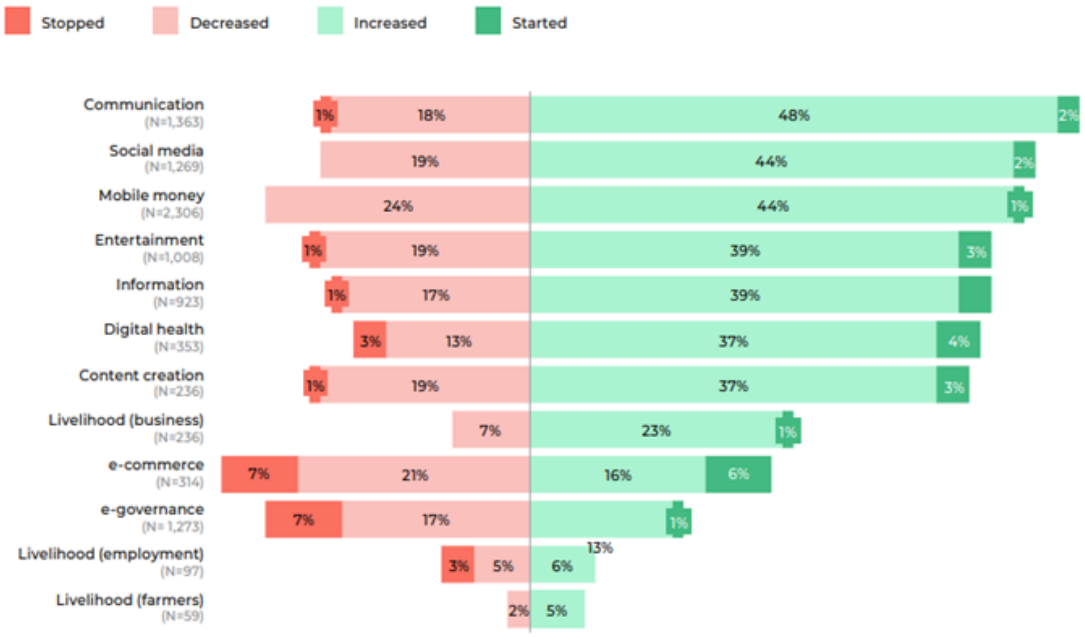

Figure 24: Change in digital services usage during COVID-19 lockdown period % of respondents

Currently, Kenya has a mobile phone ownership rate of 73.6% and internet access rate of 26.3%. Over 60% of the country is covered by network services- delivered through established firms such as Safaricom and Airtel. Kenya's Economic Report 2021 shows that Fibre to the Office (FTTO) and Fibre to the Home (FTTH) have significantly increased due to enhanced digital platforms and especially during COVID-19. The recent Kenya Digital Economy Report 2021 also revealed the degree to which Kenyans rely on and are satisfied with digital tools and services, with an overwhelming majority of people (84%) reporting that digital devices and services are making their lives better and especially through creating new connections.

By increasing internet coverage and utilization by most Kenyans, the country could enhance more awareness and market outreach on various innovations. Some of leading Kenya's giant innovations such as M-Pesa - Tekizo Africa Limited and M-Kopa have thrived in digitization as the frontier technology. Digitization has also put Kenya is the map a regional digital hub where Giants like Google, Microsoft, Samsung, and Intel find their home in Africa i.e., in Nairobi. The internet subscribers grew in the country because of improved infrastructure and access to phones and the internet. According to the 2021 economic survey, the number of Internet service providers grew from 302 in 2019 to 366 in 2020. This availability of conducive enables innovations to thrive in Kenya. Kenya and Ghana dominate the mobile money market globally ranking second and third after China (Boston Consulting Group (BCG), 2020).

b) Access to electricity

Electricity is pivotal in running various innovation activities including machinery, internet, etc. Currently, about 75% of Kenyan households have access to electricity. Special programmes such as Last Mile Connectivity programme has catalyzed access to electricity even among rural households. There is however a need to create more awareness and provide support for households on innovative usage of electricity beyond lighting. Emerging innovations such as electric cooking e.g., promoted through the Modern Energy Cooking Programme (MECS)[1] (see Atela et al., 2021), solar irrigation among others can promote widespread use of electricity for innovation.

5.5 DOMAIN 4: INCENTIVES

Incentives motivate and promote innovation. The incentives domain constitutes four sub-domains: fiscal incentives, policy incentives, business process incentives and Awards/recognition. Under this domain 29 indicators were identified in this domain out of which 12 were prioritized by stakeholders (Figure 25). The sub-domain "business process incentives" with wider impacts on commercialization and enterprise development was prioritized About 14 (50%) of the indicators prioritized are qualitative in nature while 15(60%) are quantitative. Data could be accessed for 26 (90%) of indicators. Data challenges were mainly experienced in the "fiscal incentives' sub-domain because of the difficulty of clearly linking fiscal measures to innovations.

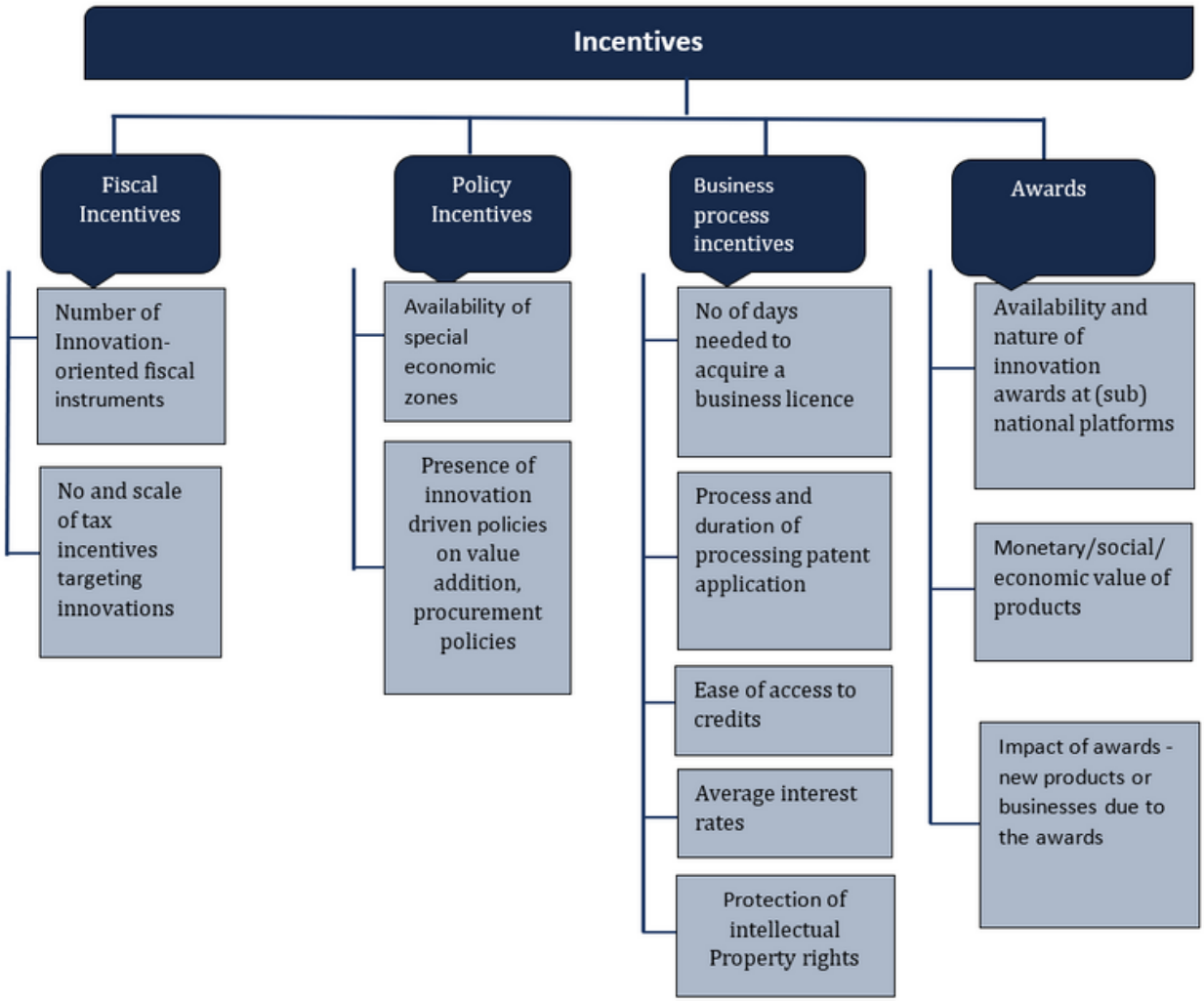

Figure 25: Indicators on Incentives

5.5.1 Fiscal Incentives

a) Innovation-oriented fiscal instruments.

To spur innovation, Kenya has put in place individual fiscal instruments to entice investors into its commercial space. The banking industry has been a key player in product and service innovation. Therefore, the fiscal related instruments that touch on innovation are mostly found in the banking and technology sector. These instruments are meant to regulate innovative goods and services such as: MPESA, M-Kesho, Pesa-Pap, M-Shwari, KCB Mtaani, Faulu Popote, ATMs mobile phone link, SMEs, Microfinance services, financial lending services and the ICT sector. The laws and policies governing the above aspects are: Central Bank of Kenya Act (2015), Banking Act (2015), Microfinance Act (2006), The National Payment System Act (2011) and the Kenya Deposit Insurance Act 2012, Central Bank of Kenya (Digital Credit Providers) Regulations 2022, Microfinance Act 2006, Microfinance Deposit Taking Microfinance Institutions Regulations, National Payment System Act (No 39 of 2011), and National Payment System Regulations 2014. These fiscal instruments speak to the regulation of financial innovation in Kenya which has grown with the wide use of services such as mobile money transfers, FinTech and credit systems.

Further, there is a Start-up Bill 2021 that is aimed at augmenting innovation in the country for SMEs, incubating businesses and increasing funding mechanisms and capital for innovation activities. The bill was passed by senate in December 2021 but is yet to be affected into law. If implemented as law, it will be a strong indicator for the growth of innovation in the country more so for start-up businesses/SMEs that need nurturing and funding in their formative stages.

b) Tax incentives targeting innovations

Kenya has a number of tax incentives targeting innovation mainly in the industry, trade and manufacture sectors. The Kenya Revenue Authority implements the issuance of the fiscal (tax) incentives in collaboration with other regulators and facilitators such as the Capital Market Authority, Export processing zones Authority (for issuance of the EPZ incentives) among others as provided under the Income Tax Act. In Kenya, the main form of tax incentives for businesses in through capital deductions.

For instance, in the 71 Export Processing Zones, companies enjoy 100% investment deduction on capital expenditure for 20 years, exemption from customs duties on imported inputs, streamlined licensing procedures under EPZ Authority and expedited customs procedures. Aside from these ad hoc incentives, these companies benefit from a 10-year corporate-tax holiday and a 25% tax thereafter. Further, there is a 10-year withholding tax holiday for such ventures and stamp duty exemption on legal instruments, 10-year withholding tax exemption on dividends and remittances paid to non-residents. EPZ companies enjoy perpetual exemption from VAT and customs import duty on inputs such as raw materials, machinery, office equipment, certain petroleum fuel for boilers and generators, building materials, other supplies. The VAT exemption also applies on local purchases of goods and services supplied by companies in the Kenyan customs territory or domestic market. These tax incentives boost Kenya's viability as an innovation haven on a regional and international plane.

5.5.2 Policy Incentives

Even though Kenya anchors its growth on innovation, innovation specific policies are still at an emerging state.

a) Special economic zones

Special economic zones are key in scaling up markets reach and growth of innovations. They are integrated modern Industrial parks designed with incentives to attract Foreign & Domestic Direct Investments with goods and services regarded, as being outside the customs. The special zones help to create a business's ecosystem for frontier innovations. They promote interactions among various innovations and market players and open opportunities for scaling-up technological and market breakthroughs. Kenya enacted Special Economic Zones Act in 2015 under vision 2030 to boost the market in competition and link different stakeholders to share their capabilities, thus creating more job opportunities. Under the Kenya's Vision 2030, three (3) world-class Special Economic Zones are anticipated:

- Greater Mombasa SEZ: 3,000 sq. km – (to create 2 million new jobs).
- Lamu SEZ: 700 sq. km – (to create 1 million new jobs) and
- Greater Mombasa SEZ: 3,000 sq. km – (to create 2 million new jobs).

A key challenge anticipated for the Kenya's SEZ, is the infrastructural connectivity issues and governance loopholes that might drain anticipated business environment for the SEZs.

b) Innovation driven policies on the promotion of local innovations and procurement policies

While Kenya's development blueprint is anchored on innovation, innovation specific policies and plans are still emerging. The country has made it favourable and attractive through its regulatory framework for foreign direct investment but has also tried to promote local innovations through various mechanisms such as provision of targeted incentives e.g. through special economic zones and export processing zones. Other regulatory frameworks, the Mining Act (2016) restricts foreign participation in the mining sector and requiring 60% Kenyan ownership of mineral dealerships and artisanal mining companies, ICT policy now requires increased Kenyan ownership in foreign companies providing ICT services from 20% to 30%. While this is the case, the country has a long way to go particular in the procurement of local goods and services, for example, government's export promotion programs have not yet distinguished goods produced by local or foreign-owned firms in the country, something that perhaps need to be enacted to promote local innovations.

5.5.3 Business Process Incentives

Kenya has made efforts in easing the establishment of business through the e-citizen platform however political stability remains a threat to business growth.

Supporting businesses and creating a conducive environment to ease business establishment growth is an important incentive. These include enablers' indicators ranging from ease of doing business, government effectiveness, and county business environment among others. In terms of ease of doing business in Kenya, it takes about 23 days to register a company in Kenya although this differs across counties with Nairobi County ranked the first, followed by Nyandarua county and Nakuru third place while Isiolo County was ranked the forty-second (Musamali & Ngugi, 2019). Time taken to acquire single business permits and to register with the tax authority has also reduced (Kenya National Bureau of Statistics, 2020) supporting a conducive environment for innovations. According to the Kenya National Bureau of Statistics survey report 2020, an improvement in transport and infrastructure allowed ease of business registration as well as and access to business licenses (42.4%) in 2018 and 2019). While Kenya performs relatively fairly in these indicators, 2021 GII ranked Kenya averagely at position 80 out of 132 with the country ranking lowest on political stability i.e., 106 out of the 132 countries ranked.

5.5.4 Awards

Awards exist but are relatively small scale to spur development of innovation ideas, but the impacts of these incentives are unclear and untracked.

Awards are becoming prominent innovation incentive scheme. A variety of innovation relevant awards currently exist including awards given during innovation weeks, the annual presidential honour award, international awards (monetary). In 2019, for instance, KeNIA awarded twenty-five (25) innovators cash prices while twelve (12) innovators were provided with grants to enable them to commercialize their products and services. In efforts to support social inclusion, recently the assistive innovation category was launched to include people living with disability and the elderly.

In 2021, KENIA coordinated the National Innovation Awards as a way of motivation and showing stakeholder support for innovation ventures country wide. The Awards came in 3 major awards categories: Big4 Innovation Award, Assistive Technology Award, and Government Agency Innovation Award with over 200 applicants. Twelve government agencies and institutions were recognised and awarded for having adjusted to technological changes and enabling innovation to spur the country including Homabay County.

Overall, four 4 innovations won the 2020/2021 National Innovation Award. They consisted of Malkia incu-brooder, Solar powered cooking boilers, Wild Eye and the Mobile Healthcare services for pastoralists. The awards were given in line with the key thematic areas which were: Agricultural and Food Technologies; Energy Systems; Manufacturing, engineering, and ICT; and Medical Technologies & Health Solution reflective of Kenya's priority areas in innovation.

While innovation awards encourage the culture of innovation and commercialization of innovation products and services, they have a relatively small effect on spurring innovation, and their impact is unclear and untracked. The local awards system needs more visibility in the country to attract more innovation applications. It also needs more funding to cater for crucial and emerging categories such as digital finance, climate technology, innovation as a tool to spur education etc. After the awards, KENIA needs to have a tracking mechanism of how the awarded funds have been utilized to propel commercial ventures and innovation start-ups. Through this, the impact of the award shows can be tracked and areas of strengthening, and capacity building identified for subsequent years.

On an international plane, Kenyan start-ups and businesses have been singled out and recognized over the years as innovation giants.

Table 3: Innovation awards from 2020-2022

YEAR	WINNER	PRIZE	INNOVATION
2022	Norah Magero	Royal Academy of Engineering's 2022 Africa Prize	Engineering Innovation with Vaccibox
2021	Solar Freeze	Ashden Award for Humanitarian Energy	Sustainable and affordable refrigeration service for food and medicine in refugee camps
2021	Jacqueline Kiage -Innovation Eye Centre	Gian Marco Moratti Award 2021	Jacqueline is the co-founder of the Innovation Eye Centre, an Eye care clinic that offers high quality, affordable and accessible eye care services to the community.
2021	Standard Chartered Bank	CIO Africa 100 Awards	Exemplary performance in digital innovation
2020	SokoWatch	E- Commerce award, AppsAfrica Awards 2020	Providing free delivery and financing of essential goods to local retailers.

5.6 DOMAIN 5: IMPACT

Currently, there is no framework for measuring the impacts of innovation activities. For this outlook, we used a select innovation case studies to understand how innovation activities yield, measure and scale-up impacts and lessons (see summary in Table 3 and detailed case study information in Annex 3). The impact domain constitutes four sub-domains: social, economic, political/cultural, and environmental impacts. Under this domain, 22 indicators were identified while 11 were prioritized by stakeholders. The "economic impacts" was prioritized as a frontier sub-domain especially its role in job creation and economic growth. 35% of the indicators prioritized are qualitative in nature while 65% are quantitative. Data could be accessed for 60% of indicators. Data challenges were mainly experienced in share of funding from non-state actors.

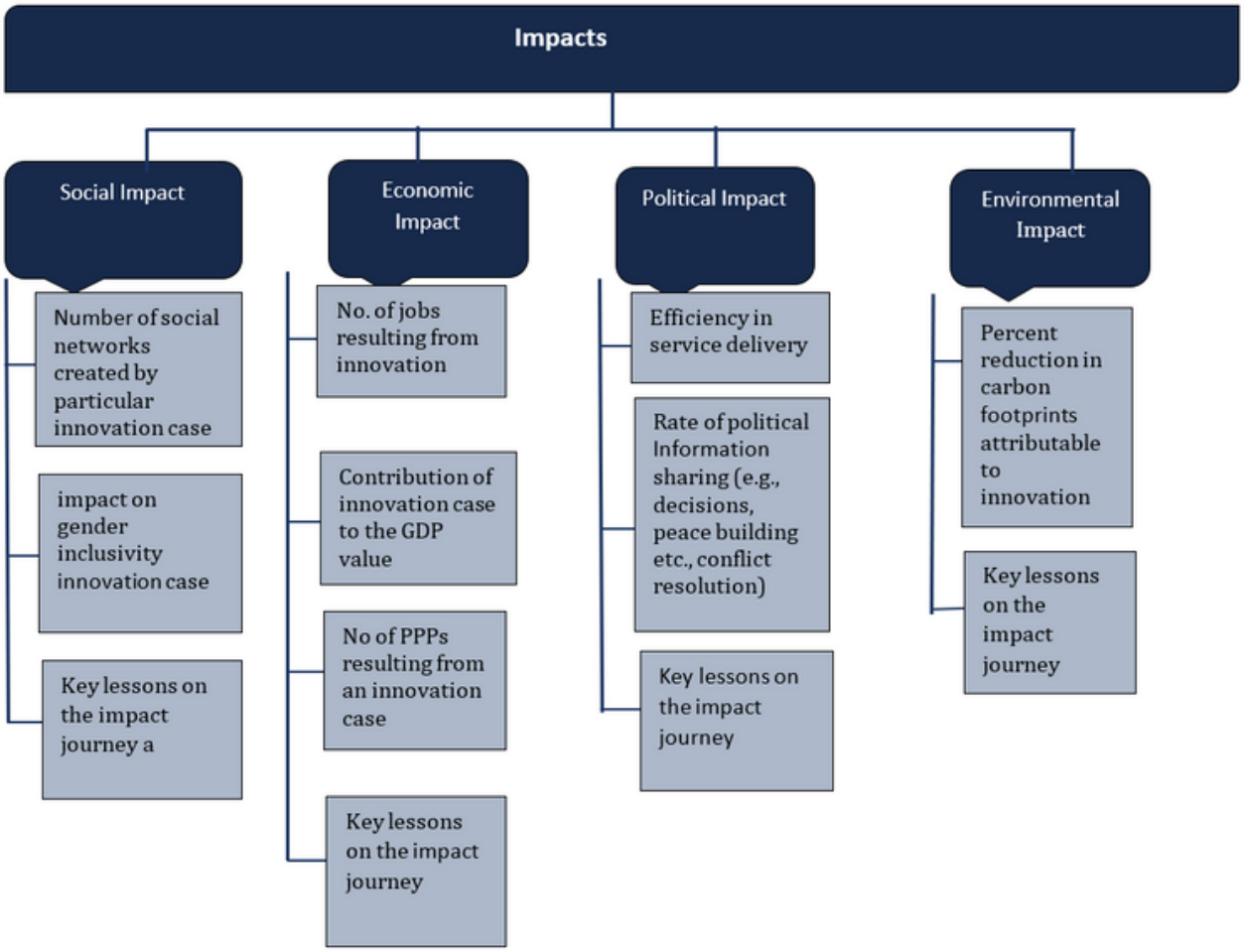

Figure 26: Indicators of Innovation Impacts

5.6.1 Social Impact

Social impacts of innovation are multiple but often overlooked due to the focus on economic impacts

A key social impact of innovation in Kenya is the strengthening of social networks. The case study of SmartBeba innovation shows that during the pandemic, innovations around digital communication and repository platforms strengthened several professional and innovators networks (See Figure 25). However, using ShopOkoa as a case study, social impact is based on every dollar that is lend out through the app to the citizen, the number of jobs created and the number of families ShopOkoa has helped meet their day-to-day emergencies.

5.6.2 Economic Impact

Under the economic impact, the study identified 6 indicators including number of jobs resulting from innovation, contribution of innovation case to the GDP, number of PPPs resulting from an innovation case and key lessons on the impact journey. Generally, Kenya's economic growth in 2021 was supported by improved performance in innovation-oriented sectors of the economy including manufacturing (6.9%), wholesale and retail trade (7.9%), real estate (6.7%), transportation and storage (7.2%), and financial and insurance activities (12.5%) (KNBS Survey 2021). Innovations in the services and industrial output sector contributed to an average economic growth of 7.5% achieved in 2021, especially in the context of COVID recovery strategies. During the review period, the number of new jobs created in the economy was 926,000 of which 172,000 were in the formal sector, while 753,000 were in the informal sector.

These jobs were not necessarily due to innovation even though according to the Kenya Economic Outlook, 2022, innovation in the service sectors and digitization, steered by COVID-19 generated several new jobs. Additionally, wage employment in the private sector increased by 6.8% to 1,984000 persons in 2021 from 1,858,000 persons in 2020. Within the public sector, wage employment increased from 884,600 thousand persons in 2020 to 923,000 persons in 2021. Notably, recent data from the Kenya National Bureau of Statistics shows total recorded employment from 17.4 million in 2020 to 18.3 million in 2021. (KNBS) 2022 Economic Survey). The case of Adanian Lab shows that during 2021, the firm put in place Venture Building innovation and through this delivered 5 Venture studios across Africa, invested in 35+ startups and 1500+ jobs. Case study interview shows that the firm focused on capacity building to achieve these impacts an indicator that for innovation to achieve much impact, it should focus or re-orient to economic impact.

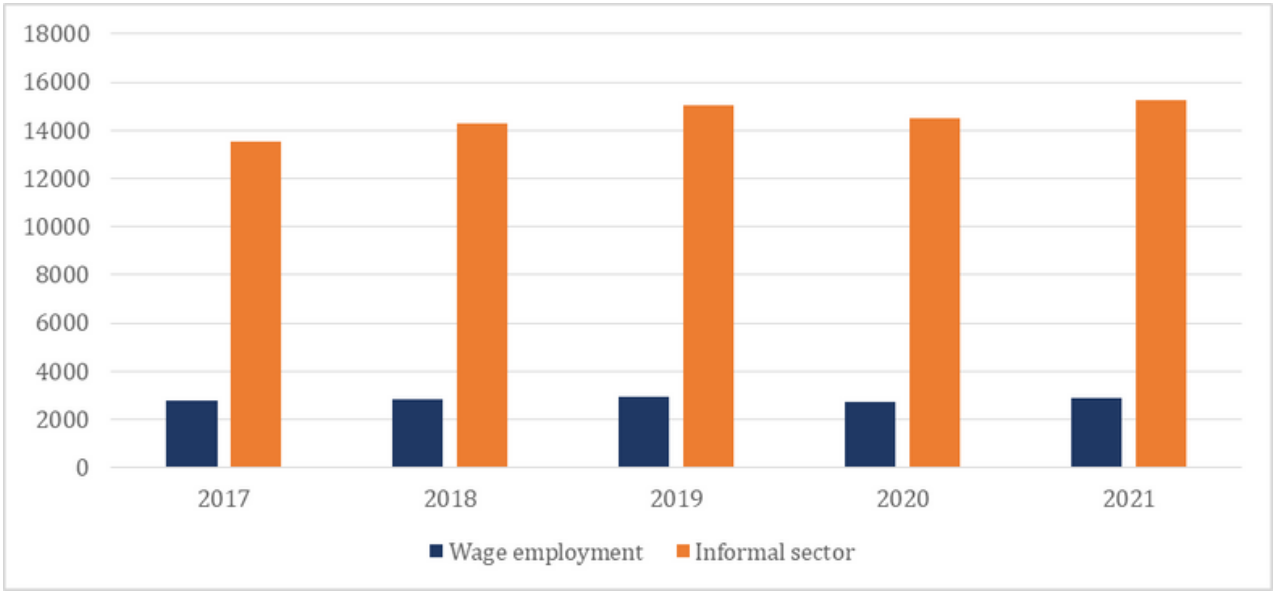

Figure 27: Age employment and informal sector employees from 2017 to 2021 in '000

An analysis of the statistic above indicates that the 2021 tally of jobs beat the 2019 pre-pandemic total of 18.1 million. The informal sector has once again birthed the most jobs recording 753,800 in new employment opportunities across the year to account for more than three quarters of all jobs created. Unfortunately, there is no specific documentation of jobs that have been created directly through innovation activities. For example, UniPron, Smugel and Smusacan innovations, because the innovator did not have sufficient funds for clinical trials despite the product being useful, some of the products were commercialized which cannot be quantified. Besides as noted by C4D lab, some of the innovators tend to shy from sharing with the institution lab their innovation despite the impact. This data was significantly missing from the KNBS report alluding to difficulty in coordination and documentation of the impact of innovation in Kenya.

Using an example of ShopOkoa, the innovation has increased convenience especially in the sector of financial services. Most ventures have now embraced mobile financial services that has increased access to goods and services through e-delivery, giving such ventures a competitive edge. According to Kenya's Digital Economy Report, 94% of Kenyans use mobile money; 44% of them increased their usage during the COVID-19 pandemic. As a nod to the increased use of mobile money, mobile subscribers increased by 8.5% to 35.2 million in 2021. Subsequently, the value of mobile commerce, which entails transactions via pay bill and till number platforms, increased from Kshs 9.4 billion in 2020 to Kshs 15.3 billion in 2021.

Whereas there are no official statistics on the number of PPPs stemming from innovation from the case study, there are opportunities to strengthen PPPs through innovation. The PPP project under the Ministry of health intended to enhance research in the medical sector and effect the manufacture local vaccines in Kenya. The project is being rolled out (it is at the prefeasibility study phase) by DAWA Group together with Merck. It proposes to put up the first Human Vaccine production plant in Kiambu with a targeted investment of over USD 45 million and projected annual turnover in excess of USD 41 million. Upon successful completion of the project, it will supply vaccines to domestic and export markets, improve local vaccine access and creating over 200 quality jobs with 30% being highly skilled. It will also boost Kenya's innovation portfolio in the health care sector by spurring health related research and the production of vaccines for exportation. It contributes to SDG 9 whose primary focus is industry, innovation, and infrastructure. It also aligns with SDG 3 on health and wellbeing which is a key pillar in Kenya's Vison 2030. With more of such PPP initiatives that bring on board private sector actor, robust economic growth would be anticipated as a long-term effect.

5.6.3 Ecological Impacts

Ecological impacts such as carbon footprints are globally recognised but are yet to be prioritised in the domestic efforts. As the world is going green, innovation has played a key role in promoting environmental sustainability in Kenya and curbing climate change in line with the Paris ambitions. The Africa Union Green Innovation Framework has identified priority sectors for catalyzing green growth including energy, digital infrastructure, forestry, agriculture, and trade. Innovation around cleaner production are critical in reducing carbon footprints and mitigating climate change according to Kenya's commitment to the Paris Agreement on reducing emissions by 32% in 2030. The ecological implications of innovations can be estimated through the innovation life cycle lens. Based on figure 30 it is eminent the identified percent reduction in carbon footprints attributable indicator is prioritized under the sub-domain which is quantitative. Using an example from the impact case study, Pyro-degrade Waste Management Ltd (Pyro-degrade Energy) innovation is pivotal towards waste recycling which is key in reducing waste disposal and thus reduction in emission of greenhouse gas. Currently, there are no clear frameworks to measure ecological impacts and there is little attention to these impacts in innovation debates. There are nonetheless a number of case initiatives that are driving ecological benefits:

The Kenya Green Initiative participate in making briquettes from rice husks. Further, the Kenya National Cleaner Production Centre (KNCPC) promotes cleaner production technologies that enhance the efficient use of raw materials, water, and energy resources. KNCPC provides technical support to industries to adopt cleaner production technologies in their systems. As such, the Centre is an important tool for the promotion of green economy in the country as it promotes activities that reduce carbon emissions, enhance efficient use of resources thus making industrial production profitable while supporting creation of job opportunities and alleviating poverty.

Additionally, institutions such as the Chandaria Business Center, KIPPI, Tumaini Center and Perdue University offers incubation, capacity building and financing options to new, small and medium business ventures and entrepreneurs that are developing innovations to address the challenges of climate change. As at 2022, it had 21 registered IPs, 298 incubated SMEs, 44 million USD mobilized for climate change and invested over 1.2 million USD in innovation enterprises. It provides technical expertise, financial assistance, and mentorship in different spheres of business management, technical skills and competencies in order to turn appropriate technologies into feasible enterprises. In so doing it had created over 20,000 jobs for the youth in the innovation sector with a specific focus on environmental sustainability.

5.6.4 Political Impact

Innovation has increased Kenya's portfolio placing it on the regional map as a favourable investment haven for innovation related commercial ventures. The ST&I Act of 2013, established innovation governance framework that have increased the incentives to innovate, including guaranteeing intellectual property rights, government assistance with the costs of research and development, and cooperative research ventures between universities and companies. The growth of innovation is dependent on the government's political good will to implement progressive sectoral policies and practices and in increasing the research funding for higher learning institutions. The upcoming 2022 elections is reliant on digital database that could minimize cases of rigging and enhance post-election stability.

Table 4: Summary of impacts from case studies

IMPACT SUB-DOMAIN	CASE STUDY	MAJOR REPORTABLE IMPACT	KEY LESSON, OPPORTUNITIES, AND CHALLENGES
Economic impact	ShopOkoa	The impact is measured based on every dollar that is lend out through the app, the number of jobs created and the number of families shopokoa has helped meet their day-to-day emergencies	Access to flexible funding and strategic partnerships. Partnerships with SACCOs in Kenya is the key opportunity
	Ajira Digital Program	The Ajira club has 35 members, Ajira Center 228 and Ajira members are oer 245. Through the training, 7774 youths have secured a job opportunity	Ajira Digital Clubs initiative focuses on creating an environment for work generation and skills development to meet the demand and supply side on job creation in all higher learning institutions in Kenya. The key lesson is that resource mobilization both internally (through profits) and externally through credits is key to economic impact of innovations. Facilitating interactions and information flow in any innovation is key to market awareness of an in novation and economic return.
	Zalego academy	Trained over 2231 students, 84 courses, 113 seasoned mentors and 1461 job placements.	Funding is a challenge is facilitating the training as the academy is self-funding.
	Smatbeba App	Number of successful startups incubated at C4DLab	Funding remains a big challenge the Lab is dependent on grants to run. Key lesson is the need for innovations to be dynamic - moving beyond 'single point' product-based interventions to stimulating the processes and paradigms.

Social impact	SIMLESA Innovation	**a.)**More farmers have taken up conservation agriculture technologies in the western region **b.)**Registration of the IP **c.)**Yield increase for maize from 8 to 16 bags per acre and beans from 1 to 5 bags per acre **d.)**More farmers have taken up conservation agriculture technologies (herbicides, crop residues left on farm, cover crops, and fodder crops.) **e.)** Farmer group plans and holds demonstrations and field days	Social impacts are largely depended on outreach through innovation foras but this also requires resource mobilization skills in central to the success of innovations. Limited technical expertise and funding
	Inceptor Innovation Centre	Creating opportunities for local talent through training on Technologies to reduce poverty and stimulate economic growth.	There is low partnership commitment and differing interests and objectives among the participating partners.
	3-wheeled agricultural vehicle.	A start-up supporting youths with agricultural machinery (the 3-wheeled vehicle). Impacts measures in terms of number of products made and sold	Getting standard approvals from KEBS is a major challenge to start-ups, impeding scaling-up. For this case, slow and expensive approval of product by KEB was a major impediment.
	Innovation Awards	In 2011, 170 applications registered their interest to participate and 11 were selected. In 2019, 318 entries were registered. In 2018, 111 innovations were evaluated for the competition. Since the inauguration of the award in 2011, the award has since recognized more than 45 new ICT products and solutions.	Awards generate useful incentives for individual innovators, but impacts of such awards could be scaled through adequate awareness and multi-sectoral focus beyond ICT.
Political	e-citizen	Number of citizens benefiting from efficient government services and information flows	Public service innovation is critical for political impact especially perception of citizens on government services.
Ecological	Pyro-degrade Energy	The amount of plastic waste recycled annually: Process ten 30kg batches of plastic per day, producing 0.6-0.7 litres of pyro-diesel from each kg of plastic waste.	Slow uptake and low interest among investors to invest in the innovation. There is need for local investors to trust our local innovations and invest in them.

5.7 DOMAIN 6: IMPEDIMENTS TO INNOVATION

Impediments are both internal and external barriers that impede innovation progress. The impediments domain constitutes three sub-domains: structural inefficiencies, economic and cultural barriers. Under this domain, fourteen (14) indicators were identified while six (6) were prioritized by stakeholders. The "Structural inefficiencies" was prioritized as a frontier sub-domain posing a significant challenge to innovation in the country.

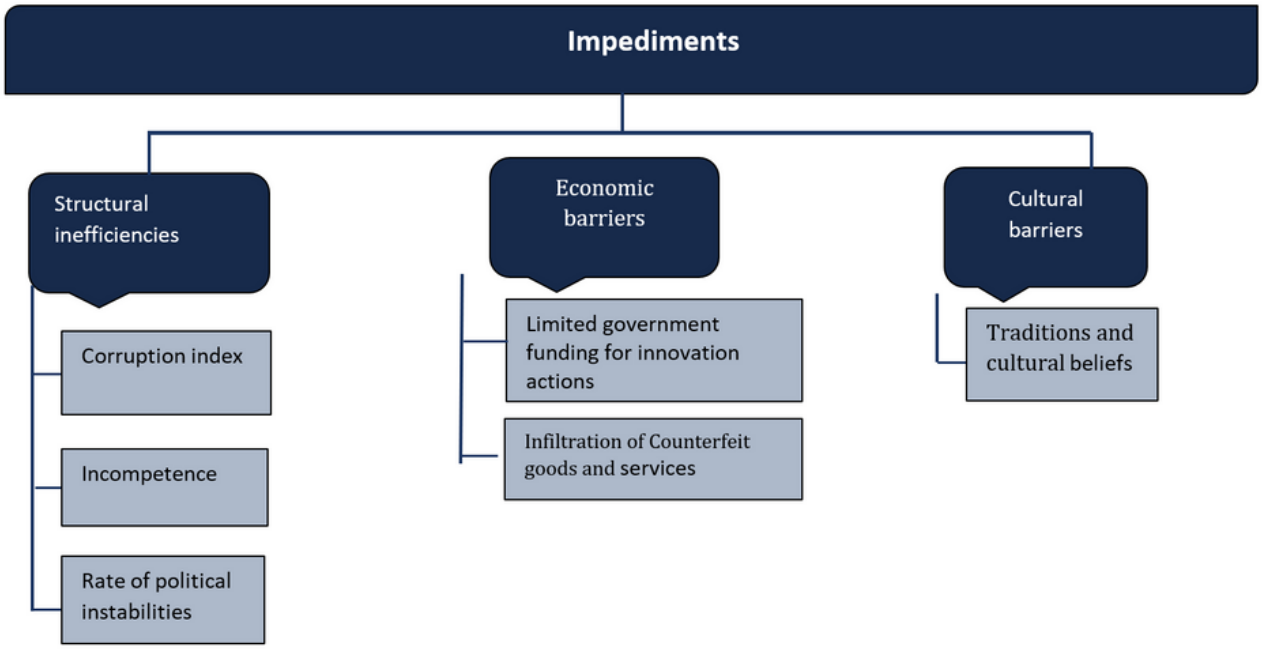

Figure 28: Impediments indicators

5.7.1 Structural Barriers.

a) Corruption Index.

Kenya scored 30 points out of 100 on the 2021 Corruption Perceptions Index reported by Transparency International. More specifically, Kenya is the 128 least corrupt nation out of 180 countries, according to the 2021 TI Corruption Perceptions Index. This affects its investment portfolio as investors are wary of financial losses and improper infrastructure to secure their innovation related ventures.

b) Incompetence

As part of the structural barrier, there is limited expertise in the innovation governance structure that is crucial in augmenting strategic innovation practices in the country. This expertise refers to enhanced professional qualification and experience among the institutions in charge of regulation, accreditation, funding and branding of the innovation sector. Currently as depicted in the academic platform domain, there exist few researchers in the Country in both academic institutions as well as in public research organizations.

Related to this challenge is the non-alignment of the innovation curricula in learning institutions. This then is a hindrance in developing the passion for innovation amongst learners and students of higher learning institutions. Unfortunately, there is low awareness of Intellectual Property Rights (IPR) among practitioners, stakeholders, and policy makers. This then translates to the low rates of commercialization of innovation products which discourages the economic growth of the innovation sector. (KENIA Strategic Plan 2018-2022)

c) Political Instabilities

Politics, at times, has a detrimental effect on the innovation sector. In Kenya, political goodwill has not been sufficiently directed in ensuring that investors and startups have a favorable environment to carry out their commercial activities. This is most evident during the election period when most businesses take extra precautions as they anticipate spates of violence. In the last election, the economy literally shut down due to an apprehension of electoral violence that has become cyclic. Still, in 2017, the Kenyan economy shed 1% of the gross domestic product due to disputes and a prolonged electioneering period.

Business organizations tend to thrive in an environment where there are strong and stable institutions, which play a crucial role in defining political, economic, and social relations. Where this is missing then the business would operate with a lot of caution thus limiting their research and development capacities. On the other hand, companies and countries must develop strategies to ensure innovation and compete in an uncertain socio economic and political environment.

5.7.2 Economic Barriers

a) Limited government funding for innovation actions

Innovation still faces the perennial problem of limited funding especially in strategic sectors such as health, manufacture, trade, and technology. For instance, Kenya Medical Research Institute (KEMRI) is the main recipient of funds for research and innovation, but only a small proportion of their research and development costs are government funded. Despite their mandate to promote Kenya's health in terms of research, the institution heavily relies on external donors to fund its activities. In 2018, the government provided only US$2.6 million of the total US$20 million KEMRI received to fund its research mandate. As opposed to government stakeholders, the private sector players have played a huge role instead in innovation funding with mega tech entities such as Safaricom allocating more than $5 million to its Spark fund for innovators in tech-enabled start-ups that are strategically aligned with its vision and with priority areas being health, agriculture and education.

Despite the increase in funding mechanisms recently, (the increase was noted after in 2020 it emerged that Kenyan startups in the African Tech Startups Funding Report, raised a record amount of funding, amounting to 19.1 billion Kenyan shillings) there is still a gap in long term funding initiatives for innovation related activities in various ventures.

b) Infiltration of Counterfeit goods and services

In Kenya, innovation also faces the impediment of counterfeit goods and services. Many brands have lost their market viability due to counterfeit goods that affect their reputation (KIPPRA, 2019). This is despite the presence of an Anti-counterfeit Authority in the country to curb such vices. There has been a difficulty in ensuring that ventures share their innovation, while at the same time prevent the counterfeiting of their goods and services. Research done by the Anti-Counterfeit Authority showed that the level of counterfeiting in major towns in Kenya stood at 23% in 2016 and 16% in 2018. A national survey by the Anti-counterfeit Authority in 2019 revealed that the value of illicit trade in Kenya is at about Kshs 726 billion. As of 2021, the government estimated that the country is losing between Ksh85 billion and Ksh100 billion annually to counterfeit and illicit trading. This discourages commercial enterprises from employing their innovations in the country when they are uncertain that they will reap the fruits of their products or services. It ultimately points to an unstable regulatory environment for goods and services. Consequently, the level of uptake and commercialization of intellectually protected products and services remains low.

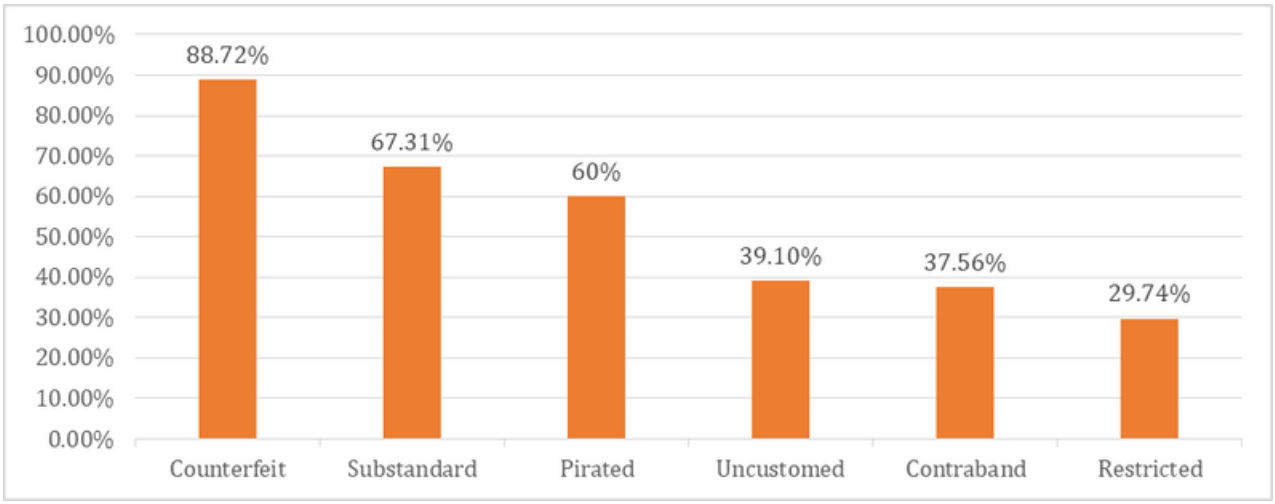

Figure 29: Most purchased form of illicitly traded products; 2019 ACA National Survey.

5.7.3 Cultural Barriers.

a) Traditions and Cultural Beliefs.

Cultural beliefs and practices slow down uptake of innovative activities. In Kenya, cultural barriers are important in the rural areas where information and awareness about innovations remain weak. For example, it took some time for Kenyans to get used to the private taxi apps that entered the market such as uber in 2015. Today, it is among the go- to -means for transport for Nairobi city dwellers. As at 2020, it had created jobs for more than 12,000 people with more than 100,000 users monthly from its inception. The e-cab market in Kenya has since attracted other market players such as bolt. The e cab business had gone ahead to gradually revolutionize the food industry in the country by the introduction of online ordering platforms such as uber eats, bolt food and glovo.

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THE SCOREBOARD

6 THE SCOREBOARD

6.1 THE SCOREBOARD INDICATORS

Drawing on the framework, over 170 indicators have been identified from various databases out of which stakeholders prioritized about 75. The indicators are mainly identified at national level and can be adjusted depending on context and relevance and emerging knowledge. It is important to note that developing contextual indicators and expected by stakeholders is a relatively complex process and can be subjective. Data availability is also an issue that will need to be addressed in subsequent outlooks. Out of the identified indicators, data could be retrieved for about 60% even though more work would be needed to verify data credibility alongside refining the indicators.

Table 5: Indicators for various domains of the KIO 2022

Domain	Subdomain	No of indicators identified	Prioritised Indicators
Domain 1: National and Global Economic Context, which defines innovation context. The recognition of innovation in national and global economic contexts is critical in legitimising and allocating resources to the innovation agenda.	National blueprints	6	• Extent of Citation/consideration of innovations in economic blueprints
	Innovation governance	7	• Presence of a dedicated innovation Agency, • Government entities dedicated to ST&I • Availability of coordination mechanism • No of staff and qualifications in STI Agencies
	Innovation policies	8	• Presence of innovation relevant policies • Availability of long-term innovation plans • No and type of treaties Kenya has signed • Availability of domestic implementation
Domain 2: Innovation life cycle/value chain, which consists of the platforms and activities that directly drive the progression of innovation, from conceptualization through development commercializing, uptake, and impact.	Discovery phase/Knowledge generation	28	**Academic/Research** • No of institutions, source of funding (private or government; focus) • No. of enrolled and graduated students • No. of STEM programmes (by level) • Presence of distinct innovation support office/directorate • No. of publications • No. of patents registered • Publication impact factor • Possession of explicit research/innovation strategy and policies • Non-academic platforms (SMEs, CBOs etc) • No of organisations (by type) with dedicated R&D infrastructure • New process/products generated

	Development /Commercialisation	21	**Academic- Universities- TTOs/commercialisation departments** • Availability of operational TTOs/Commercialisation units • Funding of commercialisation units • Average No of staff in the TTOs by gender • Share of staff with research/innovation skills/background • No. and nature of research- industry partnerships • Availability of policy • Share of publications with patent applications • Number/share of patents developed into market products **Non-academic** • Number and scale of incubation/accelerator platforms • Access to financial services • Ownership of accelerator platforms (local/international) • Access and affordability of financial services • Share of manufacturing firms that engaged in in-house R&D • No of staff dedicated to R&D by sex
	Diffusion and uptake	9	• Value of sales; no of; no of units sold from commercialised products; units • Number and scale of National and sub-national Innovation weeks • Number and scale of annual innovation discussion forum • Number of Skills and training platforms/Initiatives
Domain 3: Investments- Includes financial and infrastructural investments from both state and non-state sources.	Funding	13	• Budgetary allocation for STI from public sources • Funding from non-state sources differentiated by private and non-profit sources • FDI net inflows, % GDP (focusing on the innovation agenda) • Availability and scale of special funds (e.g., youth fund) • Diversity and nature of funding instruments (loans, grants, bonds etc.) • Share of funds with equity mechanisms in distribution

	Infrastructure/ICT	15	• Availability, nature and scale of digital platforms • Share of population above 18 years with access to internet • Share of population above 18 years connected to internet. • No of internet suppliers against population • Geographic coverage of 3G,4G,5G", cost per 1MB of data compared to other Africa and global averages
Domain 4_ Incentives: constitute the economic and legal initiatives (incentives) that the government and other players have established specifically to enhance innovations (for example, tax-breaks) by reducing costs and bureaucratic barriers to scaling up and commercialisation. These also include innovation awards aimed at encouraging innovations among others.	Fiscal Incentives	5	• Number of Innovation-oriented fiscal instruments • No and scale of tax incentives targeting innovations
	Policy incentives	8	• Availability of special economic zones • Presence of innovation driven policies on value addition, procurement policies
	Business process incentives	7	• No of days needed to acquire a business licence • Process and duration of processing patent application • Ease of access to credits • Average interest rates • Protection of intellectual Property rights
	Awards	9	• Availability and nature of innovation awards at (sub)national platforms • Monetary/social/economic value of products. • Impact of awards - new products or businesses due to the awards

Domain 5: Impacts - constitute the resultant impacts of innovations. Such impacts can be social, economic, political, environmental, or cultural occurring across sectors (health, agriculture etc.)	Social impacts	6	• Number of social networks created by particular innovation case • Number of women and girls involved in particular innovation case • Key lessons on the impact journey
	Economic Impact	6	• No. of jobs resulting from innovation case • Contribution of innovation case to the GDP value • No of PPPs resulting from an innovation case • Key lessons on the impact journey
	Political impact	6	• Efficiency in service delivery • Rate of political Information sharing (e.g. decisions, peace building etc., conflict resolution) • Key lessons on the impact journey
	Environmental impacts	4	• Percent reduction in carbon footprints attributable to innovation case • Key lessons on the impact journey
Domain 6: Impediments- constitute barriers to the value chain including cheap imports that price out local innovations from the market	Structural inefficiencies	8	• Corruption index • Incompetence • Rate of political instabilities
	Cultural barriers	4	• Traditions and cultural beliefs
	Economic Barriers	2	• Limited government funding for innovation actions • Infiltration of Counterfeit goods and services
TOTALS		**172**	**77**

6.2 DIGITAL SCOREBOARD

A web platform is designed to visualize and provide info graphs in real-time that connect to the data collection database, using a RESTful API interface that fetch data collected online using the questionnaire platform developed on the ODK platform, indicator scorecard, innovation platform tracker. The platform contains information of different user categories, each with its secure access level and a public user to view summarized STI data collected without logging into the system. For the public-facing part of the web application, graphs and maps is preferred to visualize STI pre-sourced from different scoreboards and countries repositories and allow the user to interact with the data by selecting data from different categories. The database schema is constructed using the available and normalized process: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), BCNF, Fourth Normal Form (4NF), this included: using the dashboard to visualize the tables generated, and indicators developed and established their relationship according to rules designed both to protect the data and to make the database more flexible by eliminating redundancy and inconsistent dependency and allow data query (http://kio-sti.arin-africa.org/). The configuration and user rights will be managed by KeNIA after commissioning the platform.

6.3 Frontier subdomains and recommendations

From the scoreboard, four main frontier subdomains were identified through stakeholder ranking of relevance (also see Annex 2). The frontier sub-domains provide opportunities for interventions.

6.3.1 Innovation policy

Innovation policy is a frontier sub-domain under the ''National and Global Policy and Economic context''. Kenya has mainstreamed innovation in its national blueprint, but this can only be operationalized through effective policies. Currently, the ST&I Act of 2013 presented a critical juncture in Kenya's innovation journey by establishing a dedicated national Agency to promote innovation ideas and creating a national fund supportive to innovative research ideas. While stakeholders view policies as key, there is a huge opportunity to transform the country's innovation through establishing more facilitative policies that are less restrictive, e.g., commercialization guidelines, strategies etc.

There is need to create consolidated visibility of innovation agenda in the country's development blueprints through a long term National Multi-sectoral Innovation Masterplan.

6.3.2 Commercialization

Commercialization is a frontier sub-domain under the ''Innovation Life Cycle'' domain. There is general agreement that Kenya's knowledge production outlook is relatively progressive following investments in various knowledge production platforms such as Universities and Research Institutions. However, the country is experiencing a major challenge in translating the increasing amounts of research outputs into commercial products. This has created a notion around weak research impact and subsequent low public and private investments in R&D. While Kenya is attracting domestic and foreign investments towards establishing platforms for commercializing especially outside academic platforms, e.g., start-ups and incubation hubs, investments in commercialization in academic platforms remain weak.

Strengthening commercialization units, e.g., TTOs, incubation centres within academic platforms through capacity, funding etc. presents a huge opportunity to turn huge amounts of research lying on the shelves into market products that could spur economic growth and job creation.

6.3.3 Funding

Funding is a frontier sub-domain of Kenya's Innovation Outlook under the "Investment " domain. Funding was identified to be a major gap across all the KIO 2022 domains, from the innovation conceptualization and development/commercialization to impact. Generally, funding for the ST&I sector remains low (as discussed in section 3.4) while there seems to be some progress in funding start-ups and enterprises, especially from Foreign Direct Investments and special funds such as women and youth funds.

There is need to connect the enterprise/start-up funding to university research through establishing University-led enterprises or strengthening University-enterprise linkages that directly draw from the various publications.

6.3.4 Business process incentives

Incentivising business processes, i.e., ease of doing business is a frontier sub-domain of Kenya's Innovation Outlook under the "Incentives " domain. Incentives on business process are prioritised because they could impact on wider spectrum of innovators. Various incentives exist but are relatively small scale to spur development of innovation ideas, but the impacts of these incentives are unclear and untracked.

There is need to develop an institutionalised incentive scheme strategy with clear budgetary allocation, coordination, and impact tracking system.

6.3.5 Economic impacts

Economic impact of innovation is a frontier sub-domain of Kenya's Innovation Outlook under the "Incentives " domain. Economic impacts of innovation activities are central to the country's development blueprints. The policy support towards innovation is widely hinged on economic results such as job creation, contribution to GDP as well as poverty alleviation. More specifically, innovation as a sector can contribute to enhancing the local production capacity of manufacturing firms by exploiting opportunities that have been afforded by the pandemic, such as production of hospital beds and ventilators, masks, disinfectants, protective personal equipment (PPEs) and sanitizers; mapping of micro-enterprises in manufacturing engaged in production of essential goods (such as PPEs) and other innovations in response to COVID-19. Nonetheless, there are no clear framework to track economic impacts of innovations.

There is need to align or strengthen the innovation outlook (led by KeNIA) with the national economic outlook (led by KIPPRA) to establish clearer connections.

6.3.6 Structural inefficiencies

Structural inefficiencies are a frontier sub-domain of Kenya's Innovation Outlook under the "Impediments " domain. Structural barriers especially incompetence and corruption are key impediments to innovation resulting in loss of innovation ideas as well as ushering in counterfeit products that outrun and demoralize innovation.

There is a need for certain systemic reforms, including those that deal with infringers and protects innovations from piracy and counterfeits.

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CONCLUSION AND NEXT STEPS

7 CONCLUSION AND NEXT STEPS

The primary purpose of this study was to provide a foundational framework upon which Kenya's innovation assessment can be drawn. Overall, Kenya's innovation outlook is relatively complex and still requires better coordination and consolidation. It is therefore worth stressing that the scope of this study as well as its empirical basis is limited as the findings are based on national level indicators with limited in-depth sectoral analysis beyond the national scope. It is, therefore, work in progress and may benefit from further targeted analysis especially around some of the frontier indicators or domains identified by stakeholders. The study has nonetheless succeeded in working with stakeholders to develop an inaugural contextual framework and indicators which Kenyan decision makers and stakeholders can relate with and apply in tracking innovation progress. The report, therefore, provides a template that can be enhanced and improved for assessing and coordinating Kenya's innovation activities on a regular basis. Some of the next steps to steps that could be considered include:

- Collecting and updating different domains with data that is missing. Further work in coming up with methodologies for collecting specific information/data for the different domains and subdomains is necessary to affirm the indicators.

- Need for deep drive into particular frontier sub-domains targeting the sector specific and county level analysis. Stakeholders' engagement could further help in developing the various subdomains and piloting this across Counties as a way of documenting County innovation processes and activities.

- Future outlooks might focus on specific areas especially the frontier (sub) domains identified in this study to generate detailed understanding of innovation dynamics and investment opportunities.

- Linking with the Innovation Bridge initiative. The study has highlighted the need to continuously showcase innovations in the country and data maybe updated periodically through linkages with the Innovation Bridge Initiative.

- A guideline document needs to be developed, that would seek to educate and inform those in charge of town planning on the method of harnessing the potentials within the community. The production of such a paper may well be the way the agency (KeNIA) can assist in this matter.

- Collection of data to measure innovation in the informal sector and of social innovation not amenable to classical R&D indicators remains a challenge and there is need for a longer and well-resourced study to populate this facet of the innovation outlook

The process of innovation has a spatial dimension. It is manifested in our urban centres and in the relationships that result from positive proximity and the dynamics through which we get involved in the economy. These forces are a great resource when channeled to the processes of creating a culture and solving our problems.
A common vision can be developed for the nation through a national charter or working paper with the support of KeNIA.

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REFERENCES

8 REFERENCES

1. AUDA-NEPAD (2019). African Innovation Outlook III | African Union.
2. Ayisi, J., Ndakala, F., Nyanga, R., Daniels, C., Owuor, R., Ting, B., and Wanyaman, B. (2019). Assessing the Potential for Transformative Innovation Policy in Kenya. 16.
3. F. NdaAfrican Higher Education Leadership in Advancing and Inclusive Innovation for Development (2018). Analysis of the National Innovation System in Kenya.
4. FCDO, (2020). Understanding knowledge systems and what works to promote science technology and innovation in Kenya, Tanzania and Rwanda. OJEU Publication Reference Number: 2017/S 184-377250. https://assets.publishing.service.gov.uk/media/5fca247fd3bf7f5d09db26ab/KSI_Report_FINAL_.pdf
5. GoK, (2012). The Kenya National Innovation Survey Report. Government Printer, Nairobi Kenya
6. Hall, A., Rasheed Sulaiman, V., Clark, N., Yoganand, B., 2003. From measuring impact to learning institutional lessons: an innovation systems perspective on improving the management of international agricultural research. Agricultural Systems 78, 213–241. https://doi.org/10.1016/S0308-521X(03)00127-6
7. Hall, B.H., 2020. Patents, innovation and development, National Bureau of Economic Research. doi:10.1017/CBO9781107415324.004
8. Kenya National Innovation Agency (2018). Strategic Plan 2018-2022.
9. Kruss, G., Gastrow, M., 2017. Universities and innovation in informal settings: Evidence from case studies in South Africa. Science and Public Policy 44, 26–36. https://doi.org/10.1093/scipol/scw009
10. Leach, M., Rockström, J., Raskin, P., Scoones, I., Stirling, A.C., Smith, A., Thompson, J., Millstone, E., Ely, A., Arond, E., Folke, C., Olsson, P., 2012. Transforming Innovation for Sustainability. Ecology and Society 17. https://doi.org/10.5751/ES-04933-170211
11. Ministry of Higher Education, Science and Technology (MoHEST) (2014). Kenya - Innovation Survey 2012.
12. Ndakala, F. (2017). Kenya National Innovation Indicators Survey 2015.
13. OECD/Eurostat (2018), Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg. https://doi.org/10.1787/9789264304604-en
14. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition | en | OECD'. https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm (accessed Jan. 28, 2022).
15. World Intellectual Property Organization (2021). The world's most innovative countries.
16. World Bank (2020). EConomy Profile Kenya. Doing business 2020.
17. Divakaran, S., McGinnis, P., & Schneider, S. (2018). Survey of the Kenyan Private Equity and Venture Capital Landscape. In Survey of the Kenyan Private Equity and Venture Capital Landscape (Issue October). https://doi.org/10.1596/1813-9450-8598
18. Fosci, M., Loffreda, L., Velten, L., & Rob, J. (2019). Research capacity strengthening in Low- and Middle-Income countries.
19. Kenya National Bureau of Statistics. (2020). Foreign Investment Survey 2020 Report.
20. Kenya National Bureau of Statistics. (2021). Economic Survey Report 2021. In Economic Survey 2021. https://www.knbs.or.ke/?wpdmpro=economic-survey-2020
21. Lall, S. (1992). Technological capabilities and industrialization. World Development, 20(2), 165–186.
22. Musamali, R., & Ngugi, R. (2019). County business environment for Micro and Small Enterprises in Kenya (Issue 27). Kenya Institute for Public Policy Research and Analysis. https://repository.kippra.or.ke/bitstream/handle/123456789/2080/county-business-environment-for-micro-and-small-enterprises-in-kenya-sp27.pdf?sequence=1&isAllowed=y