



Assessing the Potential for Transformative Innovation Policy in Kenya

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March 2019



1. Introduction and Context: Science, Technology and Innovation Policy in Kenya

Kenya is one of Africa's fastest growing economies; with sustained average levels of growth over the past 10 years, the World Bank re-categorized Kenya from a low-income country to a lower-middle income country¹. Kenya relatively ranks high on key science and technology indicators compared to other regional democracies. The current expenditure on R&D (% of GDP) stands at 0.48 percent, which translates to \$20 million.

The country's long-term development blue print, The Kenya Vision 2030, envisions a newly industrialized middle-income country by the year 2030². By recognizing Science, Technology and Innovation (STI) as an essential ingredient for incentivizing industrialization and economic diversification, the Vision envisages a globally competitive knowledge-based economy. In this context, science must translate into technologies and innovations that focus on addressing societal problems. Based on that, the current policy trend in the country recognizes STI as an enabler for Vision 2030 and therefore a key strategic instrument for realizing the government's Big 4 agenda of food security, manufacturing (mainly focusing on job creation), affordable housing and access to affordable universal health care to address sustainable development, through economic and social transformation³. Similarly, the constitution of Kenya as promulgated in 2010 also recognizes the role of science and indigenous technologies in national development and promotes the Intellectual Property Rights (IPR) of the Kenyan people⁴.

Finally, the 2013 STI Act was enacted to re-align STI programmes to national goals and to strengthen the national system of innovation (NSI)⁵. Instead of one organization, the act created three strategic organizations, namely, National Commission of Science, Technology and Innovation (NACOSTI), National Research Fund (NRF) and Kenya National Innovation Agency (KeNIA). The three organizations are responsible for managing and promoting STI activities including research.

This report sets the scene for transformative innovation policy (TIP) in Kenya by tracing the evolution of STI policy in the country. The report identifies the key STI policy actors in Kenya and finally how these actors particularly fit into Kenya's 3 frames of STI landscape.

2. The Evolution of STI policy in Kenya (Frame 1)

According to Schot and Steinmueller (2018), a frame 1 innovation policy approach aims at generating social benefits through R&D investment, *i.e.*, policies that respond to market failures⁶. Under this frame, basic scientific research is largely funded by government funds. Kenya's STI foundations based on frame 1 is over 100 years old. In early 19th century, the colonial government while responding to the needs of the settler community set up pioneer research services and laboratories⁷. This set the stage for the country to start its R&D investment with a focus in agricultural and health research⁸. This approach that prioritized investment in agricultural and health R&D as a strategy for fighting hunger and diseases remained in force up to the time of independence.

Following independence in 1964, it was realized that there was "no centralized responsibility for the formulation of scientific policy in the country". This contributed to poor coordination of scientific research activities and hence inadequate integration of research finding into national development⁹. For that reason, Kenya proceeded to establish a National Council for Science and Technology (NCST) and an appropriate number of Scientific Advisory Research Committees (SARCs) in their own right (*i.e.*, they were not to be part of the Council) via the Science and Technology Act (Cap 250) of 1977⁸.

Against the backdrop of the colonial era research institutes, the review of the Science and Technology Act (Cap 250) in 1979 ushered in the establishment of specialized research institutions, including the Kenya Medical Research Institute (KEMRI), the Kenya Marine and Fisheries Research Institute (KMFRI), the Kenya Agricultural Research Institute (KARI) and the Kenya Industrial Research and Development Institute (KIRDI) as national bodies responsible for research in health, marine and freshwater fisheries, crops and livestock, and industrial and allied technologies respectively¹⁰. Later on, the government integrated the Kenya Veterinary Vaccines Production Institute (KEVEVAPI) and the Kenya Tripanosomiasis Research Institute (KETRI) into KARI. In 1986, the Kenya Forestry Research Institute (KEFRI) was established to champion R&D in forestry and allied natural resources. By establishing these institutions, the independent government clearly signaled that its priority was to fix market failures through intensified R&D investment in the agricultural, industrial and health sectors. In addition, the agricultural sector continued to experience rapid establishment of commodity research foundations including Tea Research Foundation (TRF),¹¹ Coffee Research Foundation (CRF)¹² and Kenya Sugar

Research Foundation (KESREF) to cater to the research needs of tea, coffee and sugar cane. Similarly, increased government investment in R&D led to rapid expansion of research portfolios at the University of Nairobi (UoN), Moi University (MU), Kenyatta University (KU), Egerton University (EU), and Jomo Kenyatta University of Agriculture and Technology (JKUAT).

With time, more elements of frame 1 started emerging. As research institutes and universities became more specialized, there was the advent of a clear division of labour. On its part, the government took the role of funder and regulator of R&D. Scientists in the universities and research institutes built up specialized 'silos' for making scientific discoveries. The harmonious performance of the three actors; government, academia and research institutes, was assumed to lead to the industrial application of discoveries and hence adaptation by the consumers (Figure 1).

Briefly put, government funding was assumed to lead to increase in R&D and automatic translation into more innovations for fighting hunger, diseases and poverty. This assumption largely reigned between 1960s, to 1990s, and is still influencing the current political thinking and how the national system of innovation is key to realizing Kenya's "Big 4"³.

To sustain R&D investment, the government adopted R&D stimulation through tax incentives including research taxes on commodities such as sugar, tea and coffee. Revenue from these taxes was used to fund major research programmes in the country. As a result, various innovative varieties of tea and coffee were developed and commercialized, leading to the expansion of the crops in Kenya and the East African region. In addition, the government zero-rated the importation of "state of the art" research equipment and applied a mix of various tax incentives to attract foreign direct investments (FDI) in R&D. To date, Kenya is still experimenting with different models of R&D stimulation as a strategy of strengthening the national system of innovation.

Kenya's 50 years of post-independence investment in R&D with a focus on building institutions have indeed resulted in a linear model of innovation. Under the model, universities and research institutes concentrated on basic research. Generally, there was an assumption that scientific discoveries will automatically be commercialized. Further, to get value from its investments, the government had to play a delicate art of balancing between locally generated innovations and imported ones. This contributed to the retardation of R&D in key areas including engineering and manufacturing.

In the late 1990s, Kenya's R&D system had undergone intensive sector-based compartmentalization leading to "silos" and weak linkage between academia and industry.^{2,14,15} This scenario led to the agitation for the review of the Science and Technology Act of 1977, in order to allow for the strengthening of the IPR regime and the overhauling of the entire linear model of innovation.

3. Towards a National Innovation System (Frame 2) in Kenya

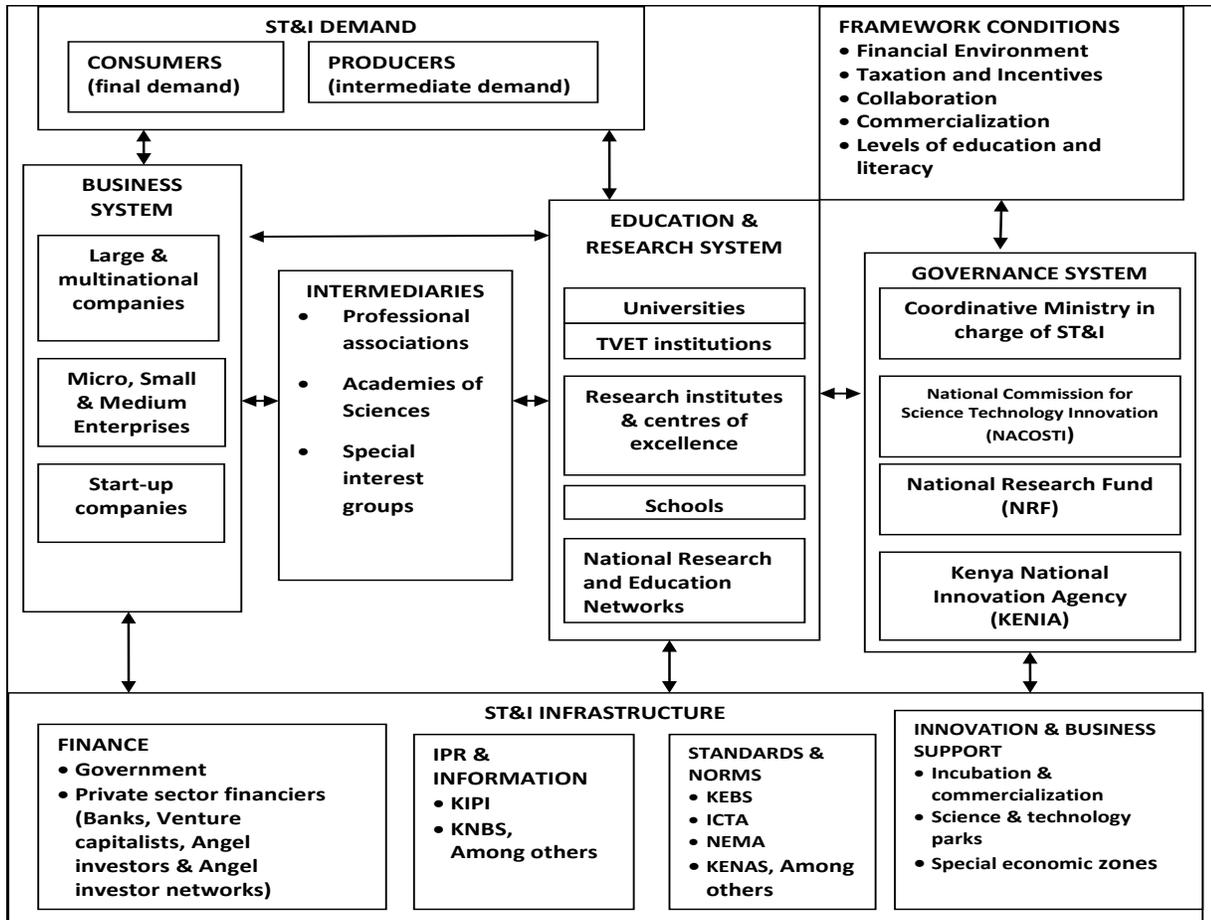
Frame 2 takes account of the systemic relationship between R&D investments and the industrial and institutional framework of a country (Figure 1), the so-called national innovation system (NIS) intersecting with sectoral, technical and regional innovation systems.¹⁶

The NIS has "centres of excellence or an entrepreneurship focus in terms of "clusters" of innovation activities. Hence before 2013, Kenya's innovation policy landscape was characterized by large institutional fragmentation, weak coordination of government efforts, donor driven financing and poor linkages between universities, research institutes and the industry. Early attempts to address these critical issues started with the development of the Kenya Vision 2030 and a raft of strategies aimed at enhancing technology transfer, promoting links between academia and industry through incubators and entrepreneurship.

The Kenya Vision 2030 was unveiled in 2007 as the country's development blue print with the goal of transforming the country into an industrialized middle-income nation by the year 2030². The Vision is being implemented in five-year Medium-Term Plans (MTPs) since 2008. The first two MTPs have already been implemented and the country is currently implementing MTP III. The Kenya Vision set out STI as a key foundation on which social, political and economic pillars of national development are anchored. The first major achievement of the Vision 2030 was the promulgation of the 2010 Constitution of Kenya which recognizes the role of science and indigenous technologies in the development of the nation; and promotes the intellectual property rights of Kenyans³. In line with the 2010 constitution, the STI sector in MTP II (2013-2017) had an overarching theme on STI¹⁷. The theme laid emphasis on policies that support the establishment of regional systems of innovation through analysis of gaps and opportunities which promotes first order learning. The plan further intensified the coordination of STI

through flagship programmes. Therefore, Vision 2030 and the 2010 Kenyan constitution significantly addressed systematic challenges in the innovation policy system in Kenya.

Figure 1: Kenya’s current National Innovation System (NIS) and major actors



Key: STI – Science Technology and Innovation; TVET – Technical, Vocational, Education and Training; NRF – National Research Fund; NACOSTI – National Commission for Science Technology and Innovation; KENIA – Kenya National Innovation Agency, IPR – Intellectual Property Rights; KIPI – Kenya Industrial Property Rights; KNBS – Kenya National Bureau of Statistics; ICTA – Information, Communication and Technology Authority; NEMA – National Environmental Management Authority; KENAS – Kenya National Academy of Sciences.

Source: Adopted from Arnold and Bell, 2001 (with modifications)¹³

4. Addressing STI Governance and Financing Challenges in Kenya

Customized to MTP II of Vision 2030 and the constitutional requirements, the government enacted the Science, Technology and Innovation (STI) Act 2013⁵, mainly to address deficiencies found in Kenya’s innovation policy landscape. The STI policy agenda shifted the focus to the building of research infrastructures, technology transfer and diffusion. Similarly, there was fast-tracking of the development of policies supporting innovation and mainstreaming STI within all sectors of the economy. The

implementation of the STI Act of 2013 created NACOSTI, NRF and KENIA, key institutions that have improved the governance of the NIS. The Act mandated NACOSTI to act as a regulator, an adviser and coordinator of STI activities in Kenya. NRF mobilizes and manages financial resources on R&D (2% of the country's GDP) and KENIA manages innovation activities including facilitating commercialization of discoveries. Thus, this TIP project therefore offers a new way of looking at these institutions and their mutual relationships.

The current institutional arrangement in the Ministry of Education (MoE) which is responsible for STI has greatly improved coordination of government efforts in the sector. The MoE has four State Departments responsible for Early Learning and Basic Education; University Education and Research; Technical, Vocational Education and Training (TVET); and Post training and skills development. The State Department for University Education and Research is in charge of departments, parastatals and agencies with mandates in university education, R&D, NACOSTI, NRF and KENIA that report to the state department through the Directorate of Research, Science and Technology (DRST). All universities report to the state department through the Directorate of University Education (DUE).

Based on the skills gaps and shortfalls, the institutional arrangement has enhanced skills development in the TVET, a sector that had been neglected for decades. Although visions and mandates of research institutes place them directly under the sectoral ministries, the STI Act of 2013 had direct impact on them. Various sector-based legal frameworks were developed in an attempt to synchronize the research institutes with NIS through strengthening the coordination of STI activities. In 2015, former KARI and Commodity Research Foundations (Tea, Coffee and Sugar research foundations) amalgamated into the Kenya Agricultural and Livestock Research Organization (KALRO)¹⁸. Currently, KALRO houses all research institutes and agencies that form the agricultural research system. Similarly, KEMRI and KIRDI have undergone changes to make them responsive to the needs of the Kenya NIS System. However, since research institutes are scattered in different ministries, the problem of weak coordination of STI activities remain persistent to date.

The steady allocations of research funds and seamless working between NACOSTI, NRF and KENIA have ensured the implementation of the government's agenda in R&D. Since its inception, NACOSTI has registered afresh all research organizations in the country. This has strengthened the regulatory

mechanisms in the country. NRF's activities cover a number of frame 2 elements. The main one being research grant calls categorized as postgraduate research grants that aimed at: alleviating the problem of aging scientists; multidisciplinary support grants that targeted establishment of links between different R&D actors and organizing technology transfer; and infrastructural support grants that targeted "state of the art" research infrastructures prioritized by NACOSTI. Through co-funding research programmes, NRF has managed to strategically partner in transformative innovation policy programmes such as Horizon 2020 of the European Union. KENIA is also implementing a similar strategy in which innovations are funded under different themes with frame 2 focus. It is worth noting that even with increased funding from public coffers, many R&D activities in Kenya remain underfunded, and hence the need to encourage private sector participation.

The MoE supports strengthening of the link between academia and the industry through the establishment of research infrastructures with private sector involvement and facilitating the establishment of intermediaries to enable translation of research findings. As a prioritized programme in MTP III, the ministry is keen on the establishment of science parks and incubators in selected public universities. In the 2018/2019 fiscal year, Dedan Kimathi University of Science and Technology will be supported to establish a science park. In the previous years, the government with support from the private sector, facilitated the University of Nairobi and Kenyatta University to establish Fablabs and Chandaria Innovation Centre respectively. To strengthen STI governance and coordination within the academia, the university Act of 2014 and the TVET Act of 2014 were enacted and implemented. The University Education Act of 2014 has led to the establishment of positions of Deputy Vice-chancellor in charge of research and innovation. This has given impetus to the development of university-based incubators and improved focus on entrepreneurship.

More importantly, most universities are collaborating with international partners to enhance knowledge transfer while, at the same time, providing new solutions. In addition, the Kenya National Educational and Research Network (KENET) facilitate the sharing of educational and research resources through broadband infrastructure and services. Apart from building of research infrastructures in technical institutions, the implementation of the TVET Act 2014 has also contributed to the establishment of strong links between middle level colleges and the private sector actors. This in turn has accelerated the technology transfer process in the sector. From another angle, the implementation

of the two acts of parliament has impacted on the division of labour. There is a notable clear division of labour among universities, TVET institutions and the industry. Whereas universities and TVET institutions are increasingly focusing on basic and applied research respectively, the government has taken a regulatory and facilitative role to ensure discoveries from the academia are utilized by the industry.

Table 1 provides an overview of the evolution of STI policy in the country, specifically the key legal frameworks that have influenced the development of the STI policy landscape through frame 1 and frame 2. The table gives a summarized account of turning point legislations that shaped the journey towards the establishment of NIS in Kenya.

Table 1: Timeline of key policy and strategy events and organizations’

1903	First research institute opens in Kenya
1963	Kenya gains independence
1970	University of Nairobi, the country’s first public university opens its doors
1977	Enactment of the first Science and Technology Act
1979	Amendment to the S&T Act set up the first public research institutes
2005	Creation of an Inter-ministerial taskforce on STI and Sector Working Groups including stakeholders from outside government
2008	Launch of Kenya Vision 2030, a national developmental plan where STI is seen as a foundation stone to success
2010	Kenya adopts a Constitution devolving power to counties and includes STI as fundamental requirements for the country’s development
	Nairobi’s I Hub opens its doors
2013	Enactment of a new Science, Technology and Innovation Act which creates new structures to assist the promotion, regulation and funding of STI in Kenya
	Launch of a Vision 2030 STI sector plan

5. Innovation Policy in the Context of Transformative Innovation (Frame 3)

Industrial society has not only led to high levels of wealth and welfare in the Western world, but also to increasing global ecological degradation and social inequality¹⁹. Therefore, many policymakers no longer opine that frame 1 and 2-based innovations are sufficient for their national needs. This is

because, such innovations focus on technical aspects, but neglect social and environmental dimensions and hence they do not address sustainable development ^{20,21}.

Governments are therefore increasingly better aligning social and environmental challenges with innovation objectives to address a number of well-chosen societal challenges such as the UN SDGs⁶. Frame 3 raises questions about the shortcomings of STI in addressing issues of social and environmental challenges. Thus, its focus on innovation is as a search process on the system level. This is guided by social and environmental objectives and does not imply that governments should completely abandon Frames 1 and 2, but re-examine challenges associated with the two frames⁶. In the context of Kenya through frame 3, the innovation policy after the STI Act of 2013 has been broadened to include civil society and citizens as key actors. Frame 3 does not assume consensus, instead the underlying innovation thrives on the need to identify and work with diversity, dissension and conflicting worldviews (*i.e.*, deep learning), recognizing the contributions which can be made by a large variety of actors. It therefore stimulates deeper alignment and coordination of the actors with the aim of producing technological change and facilitating entrepreneurship.

Frame 3 calls for “transformation” of socio-technical systems in energy, mobility, food, water, healthcare and communication, which are considered backbone systems of modern societies^{22,23}. Consequently, Kenya, like most countries, is adopting frame 3 elements through clean technologies (in energy sector), pro-poor innovations (exemplified by Mpesa mobile money), inclusive innovations (such as community health strategy including beyond zero campaigns and improved health accessibility through NHIF insurance for all), grassroots innovations and social innovations (which focus on elements such as behavioral change) are also emerging in various contexts such as Kenya’s Vision 2030 that is now emboldened in the country’s “Big 4” development Agenda (2018-2022) to address sustainable development. The Big 4 agenda lays emphasis on environmental and social benefits that move beyond public-private partnerships to embrace co-creation, directionality, societal goals and reflexivity.

Considering inclusivity as the starting point, the constitution of Kenya (2010) posed the expansion of social appropriation of knowledge production programmes to include communities and civil society and to promote effective dialogue between experts and communities. This borders frame 3 thinking, which underlie the importance of consolidating an innovation culture that includes diverse actors in the “design and the implementation of ideas for the solution of social, cultural, economic and

environmental problems”⁴. The social innovation programme represents a very different approach to hitherto STI policy making. Within a social innovation approach, technology is conceived as an instrument for development and social transformation that works outside of market dynamics. The programme aims “to increase participation of actors in the solution of their needs by articulating the results of R&D and traditional knowledge from local communities”. The Big 4 mainly focus more on policies and projects that directly impact the life of ordinary Kenyan citizens who are usually marginalized and isolated sections of society. The beauty of the Big Four vision is their resonance with issues that are pro-poor, inclusive, grassroots-based and encompass social innovations that directly affect the common person such as cost of living, jobs, shelter and health care and can be considered as a strategy to “localizing the SDGs” by aligning with Vision 2030 for their easier achievement²⁴.

6. Conclusion

This mapping provides an overview of the evolution of STI policy in Kenya and the thinking behind transformative innovation policy. Kenya like many other African countries is still locked in Frame 1 and 2. The Kenyan policies still tends to lean towards frame 2, focusing on productivity optimization from the existing institutions and laying emphasis on practices in the traditional sectors such as energy, healthcare, mobility, agriculture, food security, communication and water management. The approach still remains lacking in abilities to solve the deep long-term societal challenges captured by the SDGs. However, some elements of frame 3 that have not been institutionalized also exist in the policies, programmes and projects. This is considered as a good starting point to move from in effort to make Frame 3 more systematic in our policies. The evidence of directionality and inclusivity can be seen on the government’s directive that polices and projects should take a consultative approach and should aim at solving social challenges as identified by the communities. It is therefore clear that TIP still needs to be ingrained in our national and sectoral policies in a more systematic way especially when we consider frame 3 aspects such as demand-articulation and reflexivity that involves evaluation of array of possible alternatives.

7. Case Study for Further Investigation: Nomadic Education in Kenya

For decades Kenya has been committed to providing quality education (SDG 4) for all as the foundation to creating sustainable development. However, the education system has largely remained highly structured. Classrooms are fixed and timings and locations are inflexible. In 2010, increased pressure from non-state actors and adaptation of ICT in education contributed to the development of policy frameworks that led to Kenya's experience of various elements of frame 3 including social-technical change and inclusion in the education system. So far, Kenya has made excellent commitments to nomadic education- the development of Nomadic Education Policy Framework set out the main features, challenges and strategies for the inclusion of nomadic populations into conventional formal education system. The educational strategy for nomads has continued to combine different delivery methods (boarding and mobile schools, radio broadcasts) together with new approaches and strictly adheres to the national curriculum to ensure equivalence with the rest of Kenya.

To bring about social technical change in the structured sedentary conventional system of education, the nomadic framework has led to the expansion of mobile schools in the form of tents, boats or buses depending on the local terrain. The Kenyan Government in conjunction with UNICEF and other non-state actors have established hundreds of mobile schools for nomadic Kenyans. To improve on the inclusion, these mobile schools allow teachers to move with the groups of nomads and set up temporary schools and tents in different places. They plan their school calendar around the rainy seasons when the students do not have many household chores to carry out.

Mobile teachers are selected by the community and after training, they continue to live and move with the community as they provide continuous education for nomadic children. As a result, children can attend secular lessons for two hours in the morning and two hours in the evening. The project was transformative as it aimed to use science and technology in form of "socio-technical system changes" to meet social needs and addresses the issues of sustainable and inclusive societies.³⁶ The main component of frame 3 in the project was directionality and demand articulation. This especially applies when it is considered that the project aimed to address the challenges related to education for social development by increasing literacy in the nomadic areas through activities that transformed and empowering stakeholders.

Although Kenya has continued to experiment with a variety of delivery mechanisms while recognizing the contradiction between nomadic livelihoods and conventional schooling, no countrywide assessment of the impact of the different approaches of delivery method for nomadic education has been conducted.

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