



Kenya climate innovation center

This document is part of a collection of six case studies selected from the work conducted by the Technology Executive Committee (TEC) on "Good practices and lessons learned on the setup and implementation of National Systems of Innovation". It specifically focuses on the Kenya Climate Innovation Center (KCIC).

The Summary for Policymakers of the TEC's work presented in June 2023¹ explains that the primary objective of an innovation system is to produce, diffuse, and use innovations. To accomplish this objective, the Summary for Policymakers document identifies specific activities or functions that should be carried out to facilitate the innovation process. Based on empirical evidence, innovation studies identify seven main functions as outlined in Table 1. Evaluating to what extent an innovation system can perform these functions is necessary to identify and assess the innovation system's achievements, failures and gaps or barriers. The functions assessment found that the functions of knowledge development and diffusion (F1), entrepreneurial experimentation (F2), market formation (F3), and resource mobilization (F5) are key functions to the KCIC study case.

Table 1. Kenya case of innovation

Country	Kenya	Focus	Mitigation & adaptation
Scope	Energy supply & demand, agriculture, water, waste management	Innovation system functions (F) ^a	Key functions: F1 Knowledge development and diffusion F2 Entrepreneurial experimentation F3 Market formation F5 Resource mobilization Non-key functions: F4 Influence on the direction of the search F6 Legitimation F7 Development of positive externalities
Approach	Top-down	Starting year	2012

^a See the Summary for Policymakers of "Good practices and lessons learned on the setup and implementation of National Systems of Innovation",² and table 2 for the description of functions.

1 TEC, 2023, Summary for Policy makers: Good practices and lessons learned on the setup and implementation of National Systems of Innovation, UNFCCC Technology Executive Commission, Bonn. Available at <https://unfccc.int/tclear/tec/NSI.html>.
 2 TEC (2023).

This document begins with a general introduction of the case study, followed by a description of the legislative framework and an examination of its context within the national innovation system. This provides a foundation for a more detailed exploration of the case. These sections serve as the basis for assessing the case by analysing its functions. The last sections include additional analysis of the case's role within the national system of innovation, key success factors and lessons learned, and good practices.



1. Introduction to the case

The Kenya Climate Innovation Center (KCIC) was initially set up as a project by a consortium of partners in September 2012 as a cutting-edge facility for promoting locally sourced green technologies in the Africa region by offering financing and other services to a growing network of climate innovators and entrepreneurs.³

KCIC aims to bring about long-term mitigation and adaptation benefits with a specific focus on renewable energy, clean water, agriculture and energy efficiency. It does this through initiatives targeting reductions in greenhouse gas (GHG) emissions and enhanced access to clean energy, while the resulting benefits on livelihoods and socioeconomic sectors augment the adaptive capacity of the local population.⁴ With this in

mind, KCIC provides incubation, capacity-building and funding to business ventures for supporting innovations in off-grid energy, renewable energy, agriculture and agribusiness, water management, commercial forestry and waste management. Accordingly, the Center delivers a mix of socioeconomic and environmental outcomes, including GHG emission abatement, improved climate resilience, livelihood generation, and enhanced access to clean energy and safe drinking water. It also promotes technology transfer and local innovation through private sector engagement, business model refinement and market entry support and, as one of the institutions supporting innovations in clean technology, is engaged in mainstreaming the SDGs and climate change in national planning. It is estimated that through its interventions the Center has helped to abate over 300,000 tonnes of GHG emissions so far.

³ See <https://www.worldbank.org/en/news/press-release/2012/09/26/climate-innovation-center-opens-nairobi-unleash-kenya-green-business-potential>.

⁴ See <https://www.kenyacic.org/about-us/>.

2. Legislative framework

KCIC was not established as a result of specific Kenyan legislation, but rather set up as an international initiative. The concept of the climate innovation centres (CICs) was developed in 2010 in a joint report entitled “Climate Innovation Centers - A New Way to Foster Climate Technologies in the Developing World?”,⁵ by infoDev⁶ in collaboration with UNIDO and the United Kingdom Department for International Development (DFID).⁷ KCIC is the world’s first CIC in a global network of CICs being established under the infoDev Climate Technology Program.

From its inception until 2016, the Center operated as a consortium of four institutions – private consultancy PricewaterhouseCoopers, Strathmore University, international NGO Global Village Energy Partnership and Kenya Industrial Research and Development Institute, a government institution mandated to promote industrial research into and transfer of innovative technologies for socioeconomic development. Since 2016, the role of the Center has changed and it now functions as a local and independent non-profit company with the ability to independently raise funds, beyond the initial support it received, for carrying out its activities.⁸

Aside from the establishment of KCIC, Kenya’s research system is still under development, with only a draft science, technology and innovation policy in place in 2008 by the Ministry of Science and Technology, Republic of Kenya.⁹

However, Kenya’s national strategies for science, technology and innovation are well defined in other documents, such as the report developed by DFID to support its decision-making and among Kenyan partners.¹⁰ As per the DFID report’s, the national research policy has three main components:

- Vision 2030, which describes the country’s development programme, which aims to raise the average standard of living in Kenya to middle income by 2030
- The Science, Technology and Innovation Act 2013, which established national research institutions aimed at implementing Vision 2030 and the science, technology and innovation policy
- The Universities Act of 2012, which directs universities to produce and disseminate scholarly research and promote innovation

In the light of KCIC’s work to achieve the SDGs and implement climate action in the country, in 2018 the Kenyan Government recognized KCIC as the official implementing agency of the Promote Climate Technologies and Innovation initiative under the Vision 2030 Medium Term Plan III for 2018–2022.¹¹ The Vision 2030 Delivery Secretariat has signed a memorandum of understanding with KCIC to explore opportunities for facilitating the implementation of climate technologies and innovation in Kenya. The primary task of KCIC under the Medium Term Plan III is to support clean technology innovation.

5 See the report at: <https://thedocs.worldbank.org/en/doc/e745077a58ec6a4094560d5b40ac16d7-0350072010/original/Climate-Innovation-Centres.pdf>.

6 infoDev (see www.infoddev.org) is a global partnership programme within the World Bank Group that works at the intersection of innovation, technology and entrepreneurship to create opportunities for inclusive growth and job creation.

7 The Department for International Development (DFID) has closed in September 2020. It’s been replaced by the Foreign, Commonwealth & Development Office (FCDO).

8 In 2016, KCIC was registered as an independent company limited by guarantee. From September 2012 to May 2016, its activities were funded by UK Aid Direct and DANIDA through the World Bank. From June 2016 to December 2020, it received financial support from DANIDA for its interventions.

9 Ministry of Science and Technology, Republic of Kenya (March 2008). Science, Technology and Innovation Policy and Strategy. Available at http://www.ist-africa.org/home/files/kenya_sti-policy_mar08.pdf.

10 DFID (October 2019). Assessing the needs of the research system in Kenya. Report for the SRIA programme. Available at https://assets.publishing.service.gov.uk/media/5ef4acb5d3bf7f7145b21a22/NA_report_Kenya__Dec_2019_Heart_.pdf.

11 See <https://www.kenyacic.org/2018/02/partnership-to-promote-clean-technologies-and-innovations/>.

3. Kenyan national system of innovation

Compared with other countries in Africa, Kenya has a reasonably moderate science, technology and innovation capacity.¹² Of the country's GDP, 0.8% is spent on research and development; however, 47% of that expenditure comes from international sources.¹³ In recent times, there have been efforts to bolster the NSI by creating innovation hubs, incubators, industrial parks, centres of excellence and technology cities, and promoting private sector investment in research and development initiatives.¹⁴

The institutional framework for research primarily comprises the National Commission for Science Technology and Innovation, the National Research Fund and the Kenya National Innovation Agency.¹⁵ Most of the institutional framework for innovation in the country was established between 1992 and 2012.¹⁶

Although the national institutions have explicit visions and mandates, their constrained financial situation limits effective policy implementation, the performance of research organizations and the overall capacity of national actors.¹⁷ Many international research organizations¹⁸ and intermediary organizations are located in Kenya, making the country a significant research centre in the East African region.¹⁹ Consequently, knowledge transfer practices and intellectual property protection systems in the country are reasonably well developed. However, these are confined to a limited number of research organizations, with most research agencies and universities lacking the funds and the capacity to undertake knowledge development and dissemination activities.

In terms of green entrepreneurship, a needs assessment study by the World Bank revealed five main challenges faced by green enterprises in Kenya:

- A lack of skills, tools and insights for translating ideas into successful businesses
- Lack of access to finance, including early-stage risk financing for accelerating the launch of high-potential start-ups
- Lack of access to information
- Lack of an enabling business environment owing to the absence of a complementary policy framework or to unfavourable regulations on, inter alia, quality standards and taxation
- Lack of access to facilities, including space for establishing business incubation hubs, training facilities, meeting and networking hubs (with peers and investors), testing and demonstration facilities, and manufacturing facilities²⁰

Section 4 below deals with these issues in detail and further elaborates on the drivers and gaps in the Kenyan innovation system.

12 Kahn, M. J. (2022). The Status of Science, Technology and Innovation in Africa. *Science, Technology and Society*. Available at <https://journals.sagepub.com/doi/full/10.1177/09717218221078540>.

13 UNESCO (2016). UNESCO Science Report: Towards 2030. Paris: United Nations Educational, Scientific and Cultural Organization. Available at <https://unesdoc.unesco.org/ark:/48223/pf0000235406>.

14 Yongabo, P., & Göransson, B. (2022). Constructing the national innovation system in Rwanda: efforts and challenges. *Innovation and Development*, 12(1), pp.155–176.

15 DFID (2019).

16 Wachinga, H. (2019). National Innovation System Factors, Incentives, Culture and Institutional Linkages in Kenyan ICT Innovation Firms (Doctoral dissertation, UoN).

17 DFID (2019).

18 Such as the Royal African Society, the Pan-African University (public), the African Population Health Research Centre, the Africa Institute for Capacity Development and the African Economic Research Consortium (private).

19 DFID (2019).

20 Kiraka, R. N. (2021). Green Entrepreneurship: The Case Study of the Kenyan Climate Innovation Centre. In *Responsible Management in Emerging Markets* (pp. 83-106). Palgrave Macmillan, Cham.

4. Description of the case

Since its inception, KCIC has been the go-to institution²¹ or one-stop-shop solution²² for organizing Kenyan activities aimed at implementing innovative climate solutions designed to bring about economic development and green growth. In order to foster the implementation of mitigation and adaptation activities, KCIC performs two fundamental functions: providing knowledge support and mobilizing funds. Accordingly, over time, the Center has evolved in line with those functions and a specialized venture fund (Kenya Climate Ventures (KCV)) and a consulting arm (KCIC Consulting) have been established for funding-related activities. The role of these two entities is further elaborated below. This section starts by describing the types of activities KCIC undertakes to address the challenges mentioned above and then the working areas in which these activities are being implemented.

4.1 Type of activities

KCIC has been promoting green entrepreneurship since its launch in 2012, in particular by addressing the challenges mentioned in section 3 above:²³

- To address the lack of skills, tools and insights for translating ideas into successful businesses, KCIC provides business management mentorships, technical assistance and customized training to entrepreneurs
- To improve access to finance, KCIC has devised three different types of funding mechanisms for different phases of the innovation cycle (Figure 1):
 - Proof-of-concept grants (up to USD 50,000) as part of its incubation services
 - Seed funding for projects with the potential to graduate from incubation towards becoming commercially viable (USD 50,000 to 1 million) and investment facilitation at more advanced stages of innovation. The Center devises innovative business and funding models to help entrepreneurs overcome the ‘valley of death’ funding gaps. To generate seed funding, KCIC launched KCV in 2016 with an initial World Bank grant. Presently KCV is 100% owned by KCIC, which had invested USD 300,000 in convertible debt into the company by 2018.²⁴ The combination of KCIC as an incubator and KCV as a seed funder helps address the complexities of early-stage climate innovations, which generally have little capital and come with high risks, but have a long-term outlook²⁵
 - Early-stage risk financing for accelerating the launch of high-potential start-ups. KCIC set up an early-stage finance mechanism (ESFM) for this purpose,²⁶ funding for which is sourced from KCV or other investors. Under ESFM support is provided in the form of debt, equity and hybrid instruments to cover funding gaps faced by early-stage businesses²⁷
- KCIC increases access to information by organizing awareness-raising programmes to disseminate information on technologies, markets, knowledge and technology transfer mechanisms, up-to-date research related to different business sectors, and information on the adoption of green solutions
- To address the lack of an enabling business environment, KCIC lobbies government ministries and agencies to push a pro-green entrepreneur agenda. The Center taps into the expertise of innovators, and research and

21 Gonzalez, A., Fruman, C., Tilmes, K., & Grown, C. (2016). Trade and competitiveness global practice gender practice note: FY17-20 (No. 120480, pp.1–37). The World Bank.

22 KCIC. Welcome to Kenya Climate Innovation Center. Available at <https://www.kcicgroup.org/>.

23 Kiraka, R. N. (2021).

24 Mungai, E. (2018). Impact Investing in Africa: A Guide to Sustainability for Investors, Institutions, and Entrepreneurs. Springer.

25 Kenya Climate Ventures. Designing an Innovative Financing Model for Early Stage Clean Technology Companies. Available at <https://documents1.worldbank.org/curated/en/381371506073998670/pdf/119909-BRI-climate-technology-program-in-brief-7-designing-an-innovative-financ.pdf>.

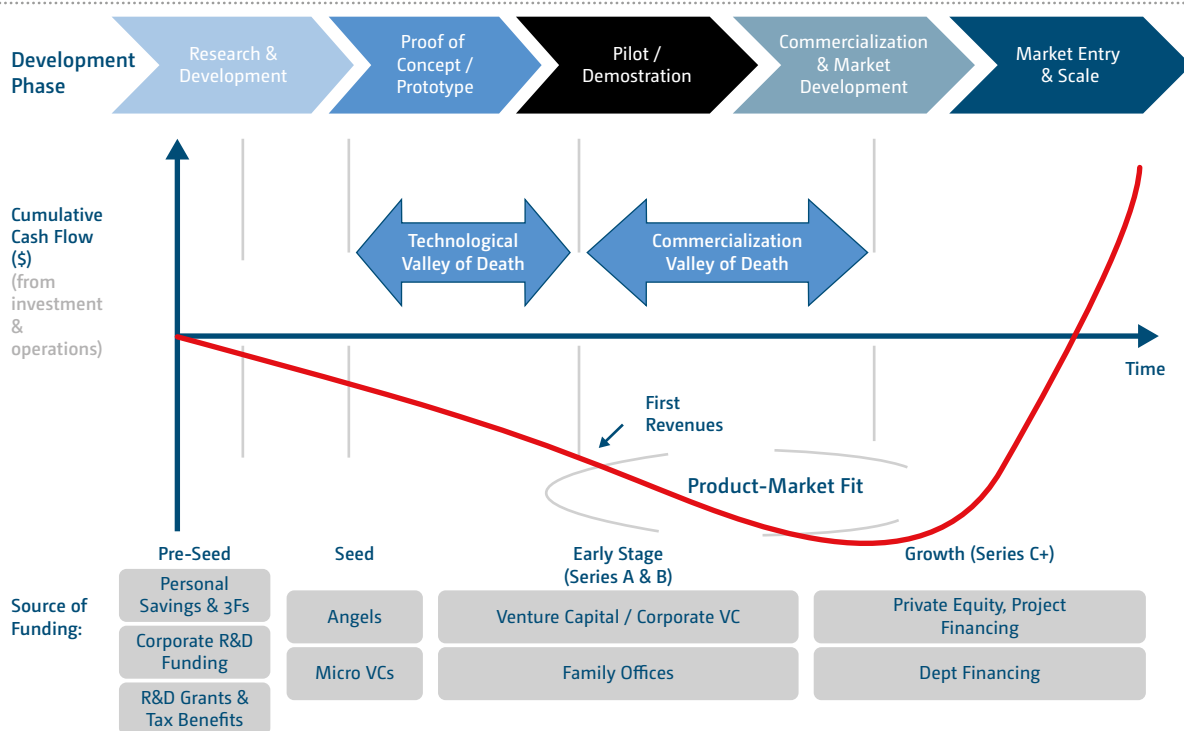
26 The success story of Acacia Innovations is one of the achievements of the ESFM. See <https://www.kenyacic.org/2019/06/acacia-innovations-esfm-success-story/>.

27 World Bank (2018). InfoDev’s Climate Technology Program Report for the July 2018 Steering Committee Meeting: FY18 Progress Report and FY19 Work Plan. Available at https://www.infodev.org/sites/default/files/ctp-scm_report_2018.pdf.

academic institutions, for example, to undertake policy advocacy work and advise entrepreneurs on regulations and related matters

- KCIC works with its partners to improve entrepreneurs' access to facilities that offer support at various stages of their business. For instance, the Center collaborated with Strathmore University Business School to set up a business incubation hub

Figure 1. Innovation life cycle and types of financing involved²⁸



Through the above activities, KCIC supports green entrepreneurship at the micro, meso and macro level:²⁹

- **Micro level:** Interventions at the level of individuals and small and medium-sized enterprises, including provision of capacity-building, technical support, financial assistance and mentorships
- **Meso level:** At the level of the value chain, KCIC operates and supports the incubation hub, the accelerator hub and the seed fund to address the funding needs of enterprises, providing advice on market development and policy-related strategies to, for example, businesses, investors and commercial banks to promote the ideation, prototyping and testing of products before their scaling up and commercialization, essentially with the aim of creating green enterprises along the value chain
- **Macro level:** At the policy and network level, KCIC collaborates with organizations such as the World Bank, governments, the Kenyan Government, and national and international academic and research institutions, for example, to provide policy advocacy and research support for green entrepreneurship, including by engaging in policy development, job creation, work on building entrepreneurship culture and infra-structure, and provision of support for research and education across multiple sectors

28 Source: Pepin, K. (2020). Financing a Tech Company's growth with Term Loans – It's all about Timing. Available at <https://kaylanpepin.com/financing-tech-with-term-loans/>.

29 Kiraka, R. N. (2021).

Over the years, KCIC has mobilized more than USD 48 million (KES 5.4 billion) to support over 1,800 start-ups.³⁰ The start-ups are estimated to have generated about USD 32 million (KES 3.6 billion) in revenues, resulting in 25,000 indirect jobs and benefitting over 780,000 people.³¹ Furthermore, KCIC undertakes special efforts to adopt an inclusive and gender-balanced approach in pursuit of its strategic goals.³² For instance, it specifically aims to support female entrepreneurs, with at least 30% of its overall entrepreneurs list comprising women. Similarly, women-led agribusinesses are preferred with 60% of the job opportunities created in the agribusiness sector aimed at women.³³ The Center trains, funds and provides technical support to women in sectors such as water, waste management and commercial forestry.³⁴ Likewise, youth entrepreneurs are prioritized.

4.2 Working areas of the Kenya Climate Innovation Center

The Center's working areas are each described below.

Agriculture and agribusiness

The agricultural sector in Kenya plays a very important role in terms of GDP, employment and exports and is an important source of industrial raw materials. However, it is hindered by smallholdership and untapped growth potential.³⁵ Smallholder farmers are relatively more vulnerable to climate risks such as droughts, floods, climate-induced pests and disease incidence, leading to productivity losses owing to the degradation of agroecological systems (including soil and water).³⁶

Furthermore, Kenya's agricultural sector is heavily reliant on the country's bimodal rainy season.³⁷ Frequent droughts lead to severe crop losses, with crops lost every three seasons. Only 1.7% of agricultural land is currently under irrigation.³⁸ Food and nutritional security continue to be a major concern for the country, particularly in the context of climate vulnerabilities, degrading soil quality and the predominance of rainfed agriculture.³⁹

To address some of these challenges, KCIC supports enterprises that develop innovative agricultural technologies and agribusiness models that offer climate mitigation and adaptation benefits, increased productivity and diversification of production systems, and generate improved livelihood options for small-scale farmers. Some of the main agribusiness ideas supported by the Center include resilient crops or seeds, climate-friendly and energy-efficient agricultural machinery, efficient irrigation, energy-efficient food processing and climate-friendly alternatives to pesticides, fertilizers, grain drying and other field operations.⁴⁰

30 Mungai, E. (March 2022). Reflecting on my decade at Climate Innovation Centre. Available at <https://www.businessdailyafrica.com/bd/lifestyle/society/reflecting-on-my-decade-at-climate-innovation-centre-3765716>.

31 Mungai, E. (2022).

32 KCIC (May 2018). KCIC_Communication_on_Engagement_Report_2016-2018. Available at https://ungc-production.s3.us-west-2.amazonaws.com/attachments/cop_2018/464457/original/KCIC_Communication_on_Engagement_report_2016-2018.pdf?1528868807.

33 Government of Kenya (2019). Guidelines for promotion, development and management of irrigation in Kenya. Ministry of Water, Sanitation and Irrigation: Nairobi, Kenya.

34 See <https://www.kenyacic.org/2022/03/women-at-the-forefront-of-a-sustainable-future/>.

35 See <https://www.kari.org/the-major-challenges/>.

36 Osumba, J. J., and Recha, J. W. (2019). Scoping study brief-Potential for adaptation and mitigation. Available at <https://cgspace.cgiar.org/bitstream/handle/10568/107338/CCAFS%20Briefing%20paper%20-%20Potential%20for%20adaptation%20and%20mitigation.pdf?sequence=1&isAllowed=y>.

37 See footnote 35 above.

38 Government of Kenya (2019).

39 Makini, F. W., Kamau, G., Makelo, M., Mose, L. O., Salasya, B., Mulinge, W., and Ong'ala, J. (2016). Status of Agricultural Innovations, Innovation Platforms, and Innovations Investment. 2015 PARI project country report: Republic of Kenya.

40 See <https://www.kenyacic.org/sectors-that-we-support/>.

Figure 2. Examples of activities supported by the Kenya Climate Innovation Center⁴¹



Left: hydroponics farming without soil; right: innovative water harvesting. Right: Images of KCIC projects published on their website <https://www.kenyacic.org/>

One of the notable initiatives of KCIC in the agricultural sector is the AgriBiz project,⁴² launched in March 2021. The AgriBiz project, a collaboration between KCIC, the African Development Bank, DANIDA, the European Union and FAO, aims to enhance food security, promote manufacturing by building on the strong links along the value chain in the sector, generate livelihoods for women and youth, set up business incubation hubs⁴³ for providing business advisory and financing services, and modernizing the agricultural sector. Table 2 shows some key initiatives supported by KCIC and KCV in agriculture and other sectors.

Energy

Kenya has a fast-growing energy sector that is heavily dependent on biomass: around 68% of the country's energy needs are fulfilled by bioenergy (mainly wood).⁴⁴ It is estimated that Kenya may lose 65% of its forests to charcoal production by 2030.⁴⁵ Petroleum and electricity account for

21% and 9% respectively of the country's total energy consumption.⁴⁶ Kenya does have significant renewable energy potential, however. In 2019, renewables accounted for 74% of the total energy mix in the country.⁴⁷ The most pressing challenges facing the Kenyan energy sector include growing energy demand with an increasing gap between demand and supply, limited grid infrastructure, a lack of access to modern and sustainable energy sources, overreliance on biomass, and rising energy costs.⁴⁸

To address these challenges, KCIC supports innovations that provide alternatives to traditional energy sources and reduce inefficient energy use in the domestic and industrial sectors. Some of the initiatives focus on off-grid technologies, including off-grid solar, biogas, biomass and wind energy, micro hydro for domestic and rural mini-grid use, and bioenergy (biogasification, biodiesel, biomass power, heating). Table 2 shows some key initiatives supported by KCIC in the energy sector.

41 See <https://www.kenyacic.org/2020/12/farming-without-soil-the-big-bet-for-achieving-food-security/> and <https://www.kenyacic.org/2019/11/how-maji-agri-solutions-is-using-social-media-to-market-his-innovative-water-technology/>.

42 See <https://www.kcicconsulting.com/kenyan-farmers-to-flourish-from-sh5bn-agribusiness-fund/>.

43 The project will establish business incubation hubs in eight counties of Kenya: Uasin Gishu, Meru, Kisii, Nyeri, Bungoma, Isiolo, Kilifi and Lamu.

44 IEA (2019). Africa Energy Outlook 2019: Overview Kenya. World Energy Outlook Special Report. Available at https://iea.blob.core.windows.net/assets/44389eb7-6060-4640-91f8-583994972026/AEO2019_KENYA.pdf.

45 Onekon, W. A., and Kipchirchir, K. O. (2016). Assessing the effect of charcoal production and use on the transition to a green economy in Kenya. *Tropical and Subtropical Agroecosystems*, 19(3), pp.327–335.

46 Takase, M., Kipkoech, R., and Essandoh, P. K. (2021). A comprehensive review of energy scenario and sustainable energy in Kenya. *Fuel Communications*, 7, 100015.

47 Takase et al. (2021).

48 Takase et al. (2021).

Water and irrigation

In Kenya, water resources are scarce and the country is characterized by a high degree of temporal and spatial variability, resulting in over 80% of the land area being classified as arid or semi-arid.⁴⁹ Over 33% of the country's water resources originate from outside of the country.⁵⁰ Around 15% of the Kenyan population is still reliant on unimproved water sources such as ponds, shallow wells and rivers, and 41% of the population does not have access to basic sanitation services.⁵¹ Around 80% of the total national water demand is derived from surface water, of which half is used for irrigation purposes.⁵² Regions with sufficient rainfall for productive agricultural land make up less than 20% of the country's land area.⁵³ Moreover, frequent droughts and floods are worsening the situation with climate variability, with an increasing population and escalating water demands further aggravating the problem.⁵⁴

Overextraction of water for irrigation purposes threatens the sustainability of surface water management in several regions.⁵⁵ Groundwater is the primary source of water for domestic users not connected to public systems. Since agriculture is the backbone of Kenya's economy, inadequate and unreliable irrigation facilities have a knock-on effect on the overall economy.⁵⁶ Despite multipronged efforts to improve irrigation coverage in the country, only 16% of the irrigation potential had been achieved by 2018.⁵⁷

KCIC is implementing a number of initiatives to address some of the challenges discussed above. In particular, the Center supports clients working on sustainable and efficient water management technologies such as solar filtration, desalination, water harvesting, efficient irrigation, biotechnology, and wastewater reuse and recycling.⁵⁸ Building on the technical expertise of other organizations, such as the Strathmore Energy Research Centre, KCIC provides training on the design, construction and maintenance of water systems.⁵⁹ The Strathmore

Energy Research Centre trains KCIC's clients (mainly SMEs) in installing and managing smart water metering solutions and in water treatment methods, among other things. Table 2 shows some key initiatives supported by KCIC in the water sector.

Waste management

In the waste management sector, KCIC facilitates the implementation of innovative methods and practices for the generation, storage, collection, transport, processing, recycling and disposal of solid and liquid waste. Activities supported by the Center include waste separation and segregation at the source, engaging local communities, reducing waste toxicity, recycling waste and upcycling it into reusable products, converting waste to energy, converting waste to compost and reducing waste generation. Table 2 shows some key initiatives supported by KCIC in the waste sector.

Commercial forestry

In the commercial forestry sector, KCIC supports the development of innovations and practices that promote responsible forestry harvesting, afforestation and reforestation and discourages the felling of trees under its GreenBiz Programme. The businesses supported by the Center focus on business models that engage local communities in commercial forestry and relate to, inter alia, marketing for trees and tree products, thrust on commercial tree species, sustainable forest management, use of technology for forest monitoring, and creation of livelihood options. KCIC recently launched the Green Economy Youth Activation Programme with support from UNDP to promote commercial forestry in the country.⁶⁰ The Programme is aligned with the broader goals of Vision 2030 and aims to address the shortfall in the forestry sector in Kenya, where the country lost 10% of its forest cover from 2001 to 2018 despite the increase in wood imports over this time. KCIC provides incubation and mentorship services for the Programme.

49 USAID (2021). Kenya Power Sector Report 2021.

50 USAID (2021).

51 See <https://water.org/our-impact/where-we-work/kenya/>.

52 USAID (2021).

53 USAID (2021).

54 UNESCO (2006). Kenya national water development report: case study. A WWAP case study prepared for the 2nd UN world water development report: Water, a shared responsibility (2006). UN-WATER/WWAP/2006/12. <https://unesdoc.unesco.org/ark:/48223/pf0000148866>.

55 USAID (2021).

56 Silva, I. D., Ronoh, G., Maranga, I., Odhiambo, M., and Kiyegga, R. (2020). Implementing the SDG 2, 6 and 7 nexus in Kenya—A case study of solar powered water pumping for human consumption and irrigation. In *International Business, Trade and Institutional Sustainability* (pp.933–942). Springer, Cham.

57 Kanda, E. K., and Lutta, V. O. (2022). The status and challenges of a modern irrigation system in Kenya: A systematic review. *Irrigation and Drainage*.

58 See <https://www.kenyacic.org/sectors-that-we-support/>.

59 Silva et al. (2020).

60 See <https://www.businessdailyafrica.com/bd/lifestyle/society/sustainable-commercial-forestry-grows-income-3508290>.

Table 2. Key initiatives supported by the Kenya Climate Innovation Center and Kenya Climate Ventures in the agricultural, energy and water sectors

Enterprise/organization	Sector	Technology	Supported by
Aviva Kenya	Agriculture	New Rice for Africa, hybrid, drought-tolerant varieties suitable for low-input agriculture	KCIC
Hydroponics Africa	Agriculture	Hydroponic farming-growing crops in mineral nutrient solutions in water instead of soil (saves water)	KCV
Eco Sawa	Agriculture	Organic pesticides (e.g. Dane Bio Pesticide)	KCV
Agrihouse Solutions	Agriculture	Climate-smart farming technologies, such as greenhouse packages, shade net houses, water-harvesting reservoirs and irrigation systems	KCV
LishaBora Hydroponics	Agriculture	Hydroponic barley fodder	KCIC
Eco-burn Char Briquettes	Energy	Char briquettes from 95% recycled agricultural waste	KCIC
Tamuwa Ltd	Energy	Biomass briquette from bagasse	KCIC
Byster Enterprises	Energy	Construction and installation of biogas plants	KCIC
Smart Cook Energy Ltd	Energy	Bioethanol-based cooking technologies	KCIC
Powerspot Kenya Ltd	Energy	Conversion of cooking heat into thermal electric energy	KCIC
Bellac Research Consultants	Energy	Distribution of home biogas systems	KCIC
Arimi tech	Water/ irrigation	Sensor-based automatic irrigation system for arid and semi-arid areas	KCIC
Takawiri Craft Enterprises	Water/ irrigation	Handmade stationery and craft items from water hyacinth	KCIC
SwissQuest Water Supplies Co Ltd	Water/ irrigation	Smart prepaid water metering solutions with integrated mobile payment systems	KCIC
Aqua Rescue Ltd	Water/ irrigation	Wastewater and water treatment solutions	KCIC
Maji Milele	Water/ irrigation	Prepaid water points	KCIC
AfricAqua	Water/ irrigation	Micro-distribution centres for water	KCIC
Taka Taka Solutions	Waste management	Development of high-quality compost from organic material; sorting of waste for recycling industries	KCIC
Ecosave Africa	Waste management	Use of microbes to recycle waste in ecotreat waste digesters; detoxification of urine before it is discharged into water systems	KCIC
Adarsh polymer Ltd	Waste management	Conversion of plastic waste into heavy oil, carbon black and other clean energy solutions by pyrolysis	KCIC
Chemolex Limited	Waste management	Removal of plastic from rivers	KCIC

5. Assessment of the case functions

KCIC adopts a holistic approach to undertaking initiatives under its working areas, facilitating both mitigation and adaptation action. This section assesses the role of KCIC in fulfilling its systemic functions, which have strengthened the structure components of the Kenyan

innovation system. The table 3 is taken from the Summary for Policymakers of "Good practices and lessons learned on the setup and implementation of National Systems of Innovation" and describes the systemic functions of systems of innovation.⁶¹

Table 3. Functions of systems of innovation^a

Number	Function	Description
F1	Knowledge development and diffusion	Expansion and intensification of the knowledge base of the innovation system, dissemination of knowledge among actors in the system, creation of new combinations of knowledge
F2	Entrepreneurial experimentation	Designing business models for emergent technologies and knowledge, practices of uncertainty reduction through experimentation with new technologies, applications and strategies
F3	Market formation	Creation of a space or an arena in which goods and services can be exchanged between suppliers and buyers. Includes processes related to definition of demand and choices, positioning (pricing, segmentation) of products, regulation of standards and the rules of exchange
F4	Influence on the direction of search	Processes that influence the direction of research of firms and other actors; that is, which technologies they explore, which problems or solutions they choose to invest in, where they channelize their resources from, etc.
F5	Resource mobilization	Processes by which the system acquires the resources required for innovation, which could be financial and human resources (workforce and capabilities), complementary assets such as infrastructure, etc.
F6	Legitimation	Mechanisms by which an emergent technology, its developers and the TIS in question attain regulative, normative and cognitive legitimacy as viewed by the stakeholders concerned
F7	Development of positive externalities	Creation of system-level utilities (or resources), such as pooled labour markets, complementary technologies and specialized suppliers, which are also available to system actors that did not contribute to building them up

^a Adapted from Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research policy*, 37(3), 407-429.

Knowledge development and diffusion: KCIC, in partnership with other organizations, provides training and capacity-building support to high-potential, growth-oriented, emergent businesses and investors, as well as local banks. The Center helps to increase the competitiveness of companies by supplying local technologies, providing information on market size, prices for various technologies and the competitive landscape, sharing market intelligence and technical and business advice on best practices, and through policy advocacy.⁶²

Resource mobilization and market formation: KCIC has devised different funding mechanisms to address the financial needs of green projects (see section 4.1). To develop and utilize human resources, the Center taps into the diverse and complementary skill sets of various organizations, including government bodies, consulting firms, academic institutions and members of civil society.

⁶¹ TEC (2023).

⁶² InfoDev (2016). Climate Technology Program In Brief-Number 2. The Kenya Climate Innovation Center - How it Operates and Lessons for Clean Technology Incubation. Available at https://www.infodev.org/infodev-files/inbrief_no.2_kcic_0.pdf.

In terms of market formation, in addition to strategies focusing on generating funds and balancing demand–supply dynamics, KCIC adopts a risk management approach. This involves managing both strategic and operational risks faced by clients across various stages of the innovation cycle, including through its Risk Management Policy, adopted in 2017.⁶³ In specific terms, KCIC addresses:

- Investment risk, through the ESFM, by helping to close valley of death funding gaps
- Reputational risk, by promoting trust-building between networks, actors, investors and donors
- Political risk, by conducting policy advocacy activities with government and international donors
- The risk of non-availability of resources, including financial and human resources, by creating appropriate networks

Together, these factors addressed by KCIC support the market formation for clean technologies.

Legitimation: To generate credibility and legitimacy for its activities, KCIC engages in depth with potential partners and beneficiaries with the purpose also of firming up the Center design and its focus areas. Although the Center does not engage in political activities directly, it

maintains good relations with the Government, regulatory agencies and other key stakeholders to facilitate the development of policies supporting technology adoption, coordinate and broker technology transfer and collaborative research and development, and undertake international networking activities.⁶⁴ In addition, KCIC performs due diligence in relation to its prospective clients, investors and collaborators before making any investment or partnership decisions.⁶⁵ It also carries out client satisfaction surveys to assess its achievements and shortcomings. KCIC is also highly conscious of its reputation vis-à-vis international partners and donors, as negative perceptions may impede the uptake and performance of projects. It participates in international networking events and activities to increase its visibility and that of associated innovators and green entrepreneurs, and of climate technology in general. Another critical factor that has enhanced the credibility of KCIC is the fact that the Center is in its third funding cycle.⁶⁶

Development of positive externalities: KCIC promotes the creation of an enabling political, financial and technological infrastructure by working in collaboration with, inter alia, government agencies, funding organizations and technology providers. This not only helps its clients but also promotes the development and implementation of clean technologies. As a result of its activities, the Center also generates jobs,

63 World Bank (2018a). Kenya Climate Innovation Center Company Report and Financial Statements for the Year Ended 30 June 2018. Available at <https://documents1.worldbank.org/curated/en/339371548740230173/pdf/KCIC-FS-2018.pdf>.

64 InfoDev (2016).

65 World Bank (2018a).

66 Kiraka, R.N. (2021).



builds the skills and creates infrastructure for future projects.

Table 4 presents the structure-function analysis of KCIC.

Table 4. Structure-function analysis of initiatives undertaken by the Kenya Climate Innovation Center

Function		Structural element	KCIC's Interventions
F1	Knowledge development and diffusion	Actors	<ul style="list-style-type: none"> Provides training, capacity-building, mentorship and customized guidance to promising, emergent projects and entrepreneurs Provides market intelligence and business advice to entrepreneurs Collaboration on research and development, funding for innovations, clean technology development and diffusion Improves the fundraising capabilities of clients Pilots and demonstrates new or innovative technologies (e.g. new rice varieties)
		Institutions	<ul style="list-style-type: none"> Acts as an interface between companies and government agencies, facilitating the creation of complementary policies and regulations with a view to promoting research, technology development, and collaboration on knowledge development (e.g. quality standards, taxation)
		Interactions	<ul style="list-style-type: none"> Organizes international and local collaboration, networking events and conferences, among other things, to promote the dissemination of knowledge and peer-to-peer learning
		Infrastructure	<ul style="list-style-type: none"> Facilitates the creation of physical infrastructure for research and research demonstrations
F2	Entrepreneurial experimentation	Actors	<ul style="list-style-type: none"> Engages with different stakeholders and promotes the development of innovative business models and funding mechanisms Income generation activities for women and youth, for example
		Institutions	<ul style="list-style-type: none"> Acts as an interface between companies and government agencies, facilitating the creation of complementary policies and regulations with a view to promoting the development of innovative business models and funding mechanisms (e.g. quality standards, taxation)
		Interactions	<ul style="list-style-type: none"> Facilitates interactions between relevant actors to promote the uptake and implementation of green business projects
		Infrastructure	<ul style="list-style-type: none"> Facilitates the creation of physical infrastructure for business implementation and stakeholders engagements
F3	Market formation	Actors	<ul style="list-style-type: none"> Funds or generates funds for green projects and develops the market supply side Raises awareness of the merits of using green technologies, developing the market demand side Undertakes risk management to encourage stakeholders participation Building the capacity of actors to engage in the market Income generation activities, leading to the creation of demand Innovation awareness-building, pilot projects to create demand for green projects/products
		Institutions	<ul style="list-style-type: none"> Acts as an interface between companies and government agencies, facilitating the creation of complementary policies and regulations with a view to promoting the development of innovative business models and funding mechanisms (e.g. quality standards, taxation) Undertakes risk management (reputational risk, funding risk, political risk, etc.) for market formation
		Interactions	<ul style="list-style-type: none"> Facilitates interactions between relevant actors to promote uptake and implementation of green business projects
		Infrastructure	<ul style="list-style-type: none"> Creates supporting market infrastructure by developing funding mechanisms, developing skills through training and providing physical space (office, networking hubs, etc.)

Table 4. (continued) Structure-function analysis of initiatives undertaken by the Kenya Climate Innovation Center

Function		Structural element	KCIC's Interventions
F4	Influence on the direction of search	Actors	<ul style="list-style-type: none"> Recognizes priority sectors for support and funding by KCIC influences the selection of sectors/project categories by the green entrepreneurs
		Institutions	<ul style="list-style-type: none"> Supports and funds clients whose businesses/innovations are aligned with the country's overall policy goals Facilitates creation of an enabling policy setting for research, development and deployment related to green projects
		Interactions	<ul style="list-style-type: none"> Facilitates interactions between business peers, funders and recipients, etc., to guide the direction of research and facilitate learning from global and local best practices, among other things
		Infrastructure	<ul style="list-style-type: none"> Creates/provides space and facilities for research, tie-ups with research organizations and universities, etc.
F5	Resource mobilization	Actors	<ul style="list-style-type: none"> Mobilizes/generates funds for projects/actors by offering different business/funding models and management of risks across the innovation cycle Builds the capacities of actors to raise funds
		Institutions	<ul style="list-style-type: none"> Engages with the Kenyan Government to facilitate funding and implementation of projects (e.g. taxation, funding collaborations)
		Interactions	<ul style="list-style-type: none"> Acts as an interface between potential funders and project implementers, and facilitates delivery of funding
		Infrastructure	<ul style="list-style-type: none"> Provides space and settings for engagements/interactions for generation of funds
F6	Legitimation	Actors	<ul style="list-style-type: none"> Conducts due diligence vis-à-vis clients, investors and collaborators Conducts satisfaction surveys to assess shortcomings and failures, etc.
		Institutions	<ul style="list-style-type: none"> Acts as the official implementing agency of the Promote Climate Technologies and Innovation initiative under Vision 2030 Engages in mainstreaming SDGs and climate change in national policymaking
		Interactions	<ul style="list-style-type: none"> Enhances the credibility of the KCIC's project/process by mediating discussions between collaborators and funders, etc.
		Infrastructure	NA
F7	Development of positive externalities	Actors	<ul style="list-style-type: none"> Creates a pool of skilled technicians to operate and maintain green projects Builds the capacities of actors to implement projects, fundraise, negotiate with collaborators and procure technologies, etc.
		Institutions	<ul style="list-style-type: none"> Acts as an interface between companies and government agencies, collaborating with the Kenyan Government to introduce policy and regulatory changes for the market penetration of clean technologies
		Interactions	<ul style="list-style-type: none"> Assists businesses in sourcing funding from international and local banks and venture capitalists Creates and strengthens green business value chains by enhancing networks
		Infrastructure	<ul style="list-style-type: none"> Creates knowledge infrastructure by engaging research organizations, universities and domain experts, etc., in projects as collaborators/mentors Creates financial infrastructure by engaging funding organizations (international, local) and venture capitalists, etc., in projects Helps businesses to access space, facilities and equipment, etc., needed for setting up offices and networking hubs, etc. Enhances value chains and business networks

6. Role of the case in Kenya's nationally determined contribution

In line with the country's sustainable development agenda and its national circumstances, Kenya's National Climate Change Action Plan (NCCAP) 2018–2022 identified critical sectors in which to undertake mitigation and adaptation action for achieving its NDC targets.⁶⁷ For GHG mitigation, the priority sectors include energy, agriculture, forestry, industry, transport and waste, while water, agriculture, land use, forestry, energy, health and infrastructure have been identified as the most crucial sectors for adaptation-related interventions. This means that KCIC's working areas significantly overlap with the priority sectors identified by the NCCAP in line with the country's mitigation and adaptation needs.

The NCCAP recognizes KCIC as one of the institutions relevant to implementing the activities outlined in the Plan. The Center's interventions play a direct role in the achievement of Kenya's NDC. KCIC helps the country to align its long-term development vision with strategies for addressing climate change issues at appropriate levels (individual/enterprise, value chain, and groups of people interconnected in networks). The Center is building actor capabilities, promoting green innovation across sectors, mobilizing climate finance, encouraging the private sector to engage in green projects, creating income generating activities, and supporting policy implementation. In association with other organizations, it is also undertaking initiatives to generate climate finance from the local private sector.⁶⁸ Kenya expects to source 87% of its climate finance needs from international sources and the remaining from local actors.⁶⁹

67 Government of Kenya (2018). National Climate Change Action Plan (Kenya): 2018–2022. Nairobi: Ministry of Environment and Forestry. Available at <https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/10/8737.pdf>.

68 See <https://www.kcicgroup.org/the-4c-kenya-sustainability-conference/>.

69 Government of Kenya (December 2020). Kenya's first NDC (Updated Version). Submission of Kenya's Updated NDC 24th December 2020. Available at <https://unfccc.int/sites/default/files/NDC/2022-06/Kenya%27s%20First%20%20NDC%20%28updated%20version%29.pdf>.



7. Key success factors and lessons learned

Lessons that can be drawn from KCIC's experience can be summarized as follows.

Organizations need to evolve and diversify with time to achieve their ultimate goals: Although initiated through external support, CICs are designed to foster technology innovation ecosystems, and are expected to evolve, expand and become diversified through learning-by-doing and eventually develop into self-sustaining, autonomous enterprises. KCIC is a successful example of this. The Center started as a consortium entirely funded by international actors, but as the Kenyan innovation system matured and KCIC's initiatives helped make green entrepreneurship popular in the country, the Center became more diversified as a result. The Center responded to the evolving needs of the Kenyan innovation system by creating a specialized entity (KCIC Consulting) for providing hands-on mentorship and guidance to emerging green businesses and a venture capital fund for addressing the investment needs of the entrepreneurs and enhancing the effectiveness of the investment. Moreover, the Center developed its capabilities to move beyond exclusively relying on foreign funding, generating alternative funding sources.

Collaborative, multi-actor partnerships are crucial for effective climate action: KCIC is an example of a robust consortium model involving different organizations from various sectors. The collaboration allows KCIC to leverage extensive and specialized local as well as international knowledge, skills and experience to create an enabling environment for implementing clean technology innovation. It also partners with specialized agencies on specific projects. The public-private, multi-actor partnership lends credibility to the Center and enhances the quality of the services provided by the Center to its clients, particularly sector-specific advice and assistance.

Funding models need to be designed for a specific sector and phase of the innovation cycle: The financing needs of an innovation project depend on its sectoral focus and goals, the risk perception of the implementers, and the phase of the project in the overall innovation cycle. Accordingly, to customize financial support to innovation projects on the basis of their specific requirements, KCIC has devised different and innovative funding mechanisms. These mechanisms not only help to address investment needs but also to alleviate

technological, political and reputational risks associated with the projects. Another critical lesson from KCIC's experience is the importance of combining incubation and accelerator funding mechanisms, which help to address many of the funding needs of clean technology businesses.

Full integration of the innovation system with host country development objectives is needed to ensure effective outcomes: KCIC's strategic outlook, focus sectors and specific activities are entirely in sync with the long-term sustainable development objectives and economic priorities of the host country. For instance, agriculture, the mainstay of the Kenyan economy, is one of the priority sectors of KCIC. Similarly, since Kenya is a water-stressed country, KCIC undertakes interventions to better manage and utilize water resources. This synergy not only lends credibility to the activities of the Center but also helps to leverage the technical expertise and technological and financial resources received or generated from external and local sources to achieve the country's overall goals. It also makes it easier for the Government to recognize KCIC's contributions and facilitate its functioning.

Local actors' engagement at the design stage is crucial for effectiveness: This engagement is the basis for setting up tailor-made CICs in different countries. The approach and strategies of KCIC are tailored to address gaps in the Kenyan innovation system in relation to climate technology and focus on promoting sustainable development in the country. Replicating KCIC's model in other country contexts may not generate similar results, however. Following the success of the Center, its consortium model was replicated in Ethiopia, but this did not generate the intended results as the actors responsible for implementing the associated initiatives did not participate in the design of the Center. Thus, besides building on external support, it is crucial to leverage the expertise and experience of local actors so as to come up with practical and compelling arrangements. This also lends legitimacy to the actions of the CIC, as is evident in the case of KCIC.

Effective interaction among local actors is vital for peer learning: Before engaging in any project, KCIC undertakes an intensive analysis of market barriers, issues in the value chain, and high-impact opportunities for innovation. For this purpose, rigorous consultations are conducted among

stakeholders, domain experts and regulators, etc. The business model designed as a result is not only crucial for generating impacts on the ground, but also results in peer-to-peer interactions that help to build collaboration, generate climate finance, and disseminate business ideas, business models and best practices, etc. Enterprises learn more when they interact with their peers and similar industries at comparable stages of business development.

There is a need for effective networking between the CICs: Interaction among the different CICs is crucial for sharing best practices, forging partnerships and drawing lessons from other countries' experiences. A peer-learning event was organized in 2019 for representatives of CICs from Bangladesh, the Caribbean, Egypt and Ghana.⁷⁰ The closed-group interaction between the CICs helped build solidarity between the participants and facilitated exchanges regarding challenges in innovation and finding solutions. However, such interactions between the CICs are not a regular phenomenon, with the potential in this regard still largely untapped.

CICs represent an example of an international collaborative initiative for leveraging global capabilities to address local climate needs. They not only promote collaboration between developed and developing countries, but also aim to generate networks and partnerships between developing countries or various CICs to bolster climate-relevant innovation.⁷¹ Effective networking between the CICs could foster exchanges of knowledge, practices

and technological information and also expedite and scale up the deployment of clean, climate-relevant technologies.

International institutions and collaboration can help local institutions to achieve effective climate action: The success of KCIC demonstrates the complementary role of international support in building local capabilities for climate-relevant technology innovation. Moreover, it also shows that collaboration, interactions and capacity-building efforts should not be limited to government-to-government exchanges. The international facilitation process should also engage local businesses and other relevant stakeholders in achieving effective and long-term outcomes. KCIC's experience illustrates that international institutions (including multilateral development organizations) can help in three main ways. First, they can foster the incubation and acceleration of technology; second, they can serve as an interface between local actors and potential funding and technological resources; and third, they can stimulate policy and market action at the local level to create an enabling ecosystem for climate action. Where local actors lack the capability or the understanding to design effective strategies, international support can help to identify the missing links in the NSI and design customized strategies, etc. In the process, international actors can provide funding, technical and policy support, after which local actors can operate independently.

70 CBIN sponsored a week-long learning event for CICs in February and March 2019. Staff from four CICs in Bangladesh, the Caribbean, Egypt and Ghana convened in Ghana to learn about each centre's programme offerings and share best practices to improve operations. See https://www.infodev.org/sites/default/files/ctp-scm_report_2019.pdf.

71 Sagar, A. D., Bremner, C., and Grubb, M. (November 2009). Climate Innovation Centres: A partnership approach to meeting energy and climate challenges. In *Natural Resources Forum* (Vol. 33, No. 4, pp.274–284). Oxford, UK: Blackwell Publishing Ltd.

8. Good practices for potential replication

The above lessons learned have led to the identification of the following good practices that might be replicable in other countries:

- *Use international collaboration to develop local capabilities and resources:* International partnerships and exchanges can be used to develop local technological, financial, political and human resources such that reliance on international support can be reduced over time. Local action should be derived from international support to create an enabling ecosystem for climate action in the long term and not be limited by a project-based mode of operation.
- *Engage both the public and the private sector:* Diverse stakeholders should be engaged to address the complexities and uncertainties associated with the innovation processes. This will also help to tap into the different capabilities and skill sets of various actors.
- *Integrate the goals of climate initiatives into local policy goals and socioeconomic priorities:* Synergies with local objectives will help to enhance participation by stakeholders and minimize risk perception. The participation of stakeholders includes gender parity and employment for youth.
- *Evolve and diversify through learning-by-doing:* International funding and guidance should be used to kick-start an initiative. However, organizations should develop their capabilities and expand their intervention areas to become independent and effective entities that remain relevant in responding to the evolving characteristics of the local context.
- *Design innovative, customized and flexible funding frameworks:* Funding models should be designed to suit the stage, scope and risk perception of innovators/firms. Funding schemes should be complemented with enabling policy and financial regimes for effective and sustained outcomes.
- *Focus on market creation for climate technologies:* For a mature and effective ecosystem for green entrepreneurship, policies, market structures and actors should seek to create sustained demand and supply dynamics for clean technologies.



TEC

About the Technology Executive Committee

The Technology Executive Committee is the policy component of the Technology Mechanism, which was established by the Conference of the Parties in 2010 to facilitate the implementation of enhanced action on climate technology development and transfer. The Paris Agreement established a technology framework to provide overarching guidance to the Technology Mechanism and mandated the TEC and CTCN to serve the Paris Agreement. The TEC analyses climate technology issues and develops policies that can accelerate the development and transfer of low-emission and climate resilient technologies.

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