KENYAN SPACE INNOVATION ECOSYSTEM REVIEW:

ASSESSING AND MAPPING THE KENYAN SPACE INNOVATION ECOSYSTEM

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RISA Research and Innovation Systems for Africa

KSA

riis ENABLING INNOVATION

NB: This document was compiled by the Research Institute for Innovation and Sustainability (RIIS) in collaboration with the Kenya Space Agency (KSA), with support from the United Kingdom International Development (UKID) through the Research and Innovation Systems for Africa Fund (RISA Fund) programme.

EXECUTIVE **SUMMARY**

The Republic of Kenya continues to demonstrate its commitment to leveraging innovation and technological advancements to tackle its socio-economic needs. This commitment is evident in the space sector, where the applications of space data are increasingly benefiting key national priority sectors, such as agriculture and natural resource management. To ensure the continued sector growth and increased overall contribution to economic development, the Kenya Space Agency (KSA) in partnership with the Research Institute for Innovation and Sustainability (RIIS), supported by the United Kingdom International Development (UKID) through the Research and Innovation Systems for Africa Fund (RISA Fund) programme, embarked on drafting a comprehensive roadmap for the space sector innovation ecosystem in Kenya by means of an Ecosystem Maturity Assessment (EMA).

The Ecosystem Maturity Assessment (EMA) offers an in-depth analysis of the current state of Kenya's space innovation ecosystem. It evaluates the ecosystem's performance based on a range of maturity criteria, identifying key strengths, weaknesses, and challenges within the sector: first, an assessment of Kenya's space innovation ecosystem using five of the IDIA ecosystem-strengthening goals; and second, a benchmarking exercise that compares Kenya's space ecosystem with those in East Africa, across the African continent, and with selected global space ecosystems.

Key insights from the EMA highlight that considerable efforts have been directed towards building networking assets and fostering a culture of innovation within the ecosystem, notably through major convening events like the Kenya Space Expo and Conference 2024 and the Africa Earth Observation Challenge. While funding availability and overall activity in the space sector have increased, there remains significant opportunities for further growth. These not only entail the expansion of funding but also the promotion of the broader application of space data and technology across various sectors where usage is currently limited. A disconnect persists between the skills required by the space sector and the training available, which continues to hinder the sector's potential for growth. Furthermore, there is a lack of awareness of the potential applications of space data and technology, which has limited utilisation.

To overcome these challenges and unlock its potential, the Kenyan space innovation ecosystem will need to:

i. Raise awareness and ignite curiosity about the space sector and its potential to transform the nation's growth.

ii. Harness Kenya’s entrepreneurial spirit and technological prowess to accelerate the adoption of space data and technology as well as drive innovation across various industries.

iii. Establish Communities of Practice (CoP) to encourage collective approaches towards growing the space sector and enhancing stakeholder engagements.

iv. Collaborate with local universities to align on courses and training programmes that will cultivate the skilled talent needed to create a thriving space ecosystem.

v. Leverage the role of KSA to boost public investment as well as to unlock other investments and propel the space sector to new heights.

The regional space ecosystem benchmarking exercise showed that Kenya is currently one of the leading space ecosystems in East Africa – from space activity and public and private sector participation to the overall size of its funding landscape. Although Kenya is still among the leading space ecosystems on the continent, there are some insights that Kenya can gain from the development pathways of more mature space ecosystems such as South Africa and Egypt, which may enhance its unique industrialisation pathway.

This report is structured to showcase the ecosystem maturity assessment followed by lessons learned and recommendations.

NOTE FROM **KSA**

According to research by World Economic Forum, the value of the space economy in 2023 was projected to be $630 billion growing at an average of 9% per annum. Our contribution of Africa as a continent has been estimated to be less than 5% of the global space economy. Kenya as a country had not undertaken an in depth analysis to better understand the value proposition of our space ecosystem to the country. I am glad to note that our collaborative efforts with RIIS, with funding support from RISA has enabled us to review our space ecosystem and will be used to guide the roadmap development process to come up with interventions to nurture and support the growth of Kenya’s space sector. The involvement of KSA in this process has facilitated the deeper understanding of the ecosystem and provided an opportunity to engage with our stakeholders. The insights gathered through this process will enable us to effectively curate essential information on Kenya’s burgeoning space sector but also create opportunities to attract global collaborators.

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AfSA	African Space Agency
AIT	Assembly Integration and Testing
ALC	African Leadership Conference
ARMC	African Resource and environmental Management satellite Constellation
BEA	Bureau of Economic Analysis
CAST	China Academy of Space Technology
CICYT	Interinstitutional Council for Science and Technology
CITEDEF	Scientific and Technical Research Institute of Defence
CNEA	National Atomic Energy Commission
COFECyT	Federal Council of S&T
CONAE	National Space Activities Commission
CONICET	National Scientific and Technical Research Council
CoP	Communities of Practice
COPUOS	Committee on the Peaceful Uses of Outer Space
CTA	Aerospace Technological Centre
DEI	Diversity, Equity and Inclusion
DSA	Defence Space Administration
EAC	East African Community
EgSA	Egyptian Space Agency
EMA	Ecosystem Maturity Assessment
ENACOM	National Communications Entity
EO	Earth Observation
ESA	European Space Agency
ESSS	Ethiopian Space Science Society
ESSTC	Ethiopian Space Science and Technology Council
ESSTI	Ethiopian Space Science and Technology Institute
GeoHub	National Geospatial Hub
GIS	Geographic Information Systems
GLOBE	Global Learning and Observation to Benefit the Environment
GSOA	Global Satellite Operator's Association
HartRAO	Hartebeesthoek Radio Astronomy Observatory
HMO	Hermanus Magnetic Observatory
IAF	International Astronautical Federation
IAR	Institute of Radio Astronomy
IDIA	International Development Innovation Alliance
INTI	National Institute of Industrial Technology
ITA	Italian Space Agency
JAXA	Japan Aerospace Exploration Agency
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural and Livestock Research
KASA	Kibera Aeronautics and Space Academy
KENIA	Kenya National Innovation Agency
KMD	Kenya Meteorological Department
KSA	Kenya Space Agency
MESRS SR	Ministry of Education, Science and Research and Sport
MSME	Micro, Small and Medium Enterprise
NARSS	National Authority for Remote Sensing & Space Sciences
NASRDA	National Space Research and Development Agency
NGO	Non-governmental organizations
NRSC	National Remote Sensing Centre
NSC	National Space Council
NSDI	National Spatial Data Infrastructure
ODPC	Office of the Data Protection Commissioner
OECD	Organisation for Economic Cooperation and Development
RSA	Rwanda Space Agency (context dependent)
RSA	Remote Sensing Authority (context dependent)
RCMRD	Regional Centre for Mapping and Resources for Development
RIIS	Research Institute for Innovation and Sustainability
RISA Fund	Research and Innovation Systems for Africa Fund
SANSA	South African National Space Agency
SGAC	Space Generation Advisory Council
SKA	Square Kilometre Array
SMA	Stakeholder Mapping and Analysis
SSGI	Ethiopian Space Science and Geospatial Institute
SSPA	Slovak Space Policy Association
STA	Space Technology Agency
TAI	Turkish Aerospace Industries
ToC	Theory of Change
TUA	Turkish Space Agency
TÜBİTAK UZAY	Turkish Space Research Institute
TÜRKPATENT	Turkish Patent and Trademark Office
UK ATC	UK Research and Innovation and UK Astronomy Technology Centre
UKID	United Kingdom International Development
UNOOSA	United Nations Office for Outer Space Affairs
UoN	University of Nairobi

1 PROJECT BACKGROUND

The Kenya Space Agency (KSA) in partnership with the Research Institute of Innovation and Sustainability (RIIS), supported by the United Kingdom International Development (UKID) through the Research and Innovation Systems for Africa Fund (RISA Fund) programme, embarked on a review of the innovation ecosystem and creation of a space innovation ecosystem roadmap for the space sector in Kenya.

To guide the assessment of the ecosystem, stakeholder mapping and ultimately the roadmap development, a Theory of Change (ToC) found in **Appendix 1: Theory of Change (ToC)** was developed to guide the four "stages" of the innovation ecosystem review and subsequent roadmap development process, namely:

Through research on the global context outlined in **Appendix 2: Global, Regional and Kenyan Space Context,** the Kenyan Space ecosystem has been identified as a key space ecosystem on the continent. This is because Kenya has continually utilised innovation to address its developmental socio-economic needs.

- **Ecosystem Maturity Assessment**
- **Stakeholder Mapping and Analysis**
- **Roadmap Development & Intervention Prioritisation**
- **Implementation**

To achieve its goals, **Kenya aims to invest in research and development, infrastructure, data and space-based products and services to encourage space entrepreneurship, encourage innovation, and foster the emergence of space start-ups** (Kenya Space Agency , 2023).

1.1. PURPOSE AND OBJECTIVES

The purpose of the innovation ecosystem review process is to:

Foster a vibrant and robust space innovation ecosystem.

Create a clear pathway of synergies between different sectors and industries and the space sector.

Ensure an inclusive approach to the development of the space innovation ecosystem.

As a result of this, the three overarching objectives of the innovation ecosystem review are as follows:

To ***create broad market awareness of Kenya's space innovation ecosystem, highlighting efforts to leverage economic opportunities through space-based technologies***, while further elevating Kenya's (and particularly KSA's) space profile.

To ***enhance capacity within Kenya's space sector*** by fostering connections and collaboration among existing and potential stakeholders.

To ***attract potential investors, donor agencies and Kenyan national government departments to innovative companies operating in the sector, and to the benefits of space-based technologies for meeting Kenya's development goals and challenges.***

Figure 1: Project prioritised IDIA Ecosystem Strengthening Goals

ASSESSING THE MATURITY OF THE **KENYAN SPACE ECOSYSTEM**

This section presents an assessment of Kenya's space innovation ecosystem through the IDIA Framework. It presents a detailed examination of the Kenyan space value chain, evaluates the maturity of prioritised IDIA goals, and contains a benchmarking of global space ecosystems to validate the maturity rating for Kenya's ecosystem. Additionally, it includes a stakeholder mapping and a comprehensive analysis of space ecosystems.

2

IDIA FRAMEWORK FOR **ANALYSIS**

According to the International Development Innovation Alliance (IDIA) framework, which has guided this innovation ecosystem review, and can be found in **Appendix 3: IDIA Goal Prioritisation**, an innovation-oriented ecosystem is focused on the innovation process. This framework measures the extent to which various actors in the ecosystem work together cohesively towards supporting the creation of new ideas and creating an enabling environment for innovation to reach scale (IDIA, 2021). The IDIA framework highlights nine specific goals that, if well-developed, will catalyse the effectiveness of innovation in any ecosystem, namely:

2.1. PRIORITISED IDIA GOALS AND METHOD OF ASSESSMENT

For the purposes of the ecosystem maturity assessment and the stakeholder mapping and analysis, five of the nine IDIA goals were prioritised in alignment with the Kenya Space Agency's priority objectives. The prioritisation process involved a deep analysis of key strategic documents along with consultations with KSA to ascertain a list of 12 key considerations for building a robust space innovation ecosystem in Kenya. Each of the nine IDIA goals were then scored based on their relevance to each item on the list of the 12 key considerations. The five IDIA goals with the highest overall score were then selected for a deeper analysis.

This prioritisation process has been captured in more detail in **Appendix 3: IDIA Goal Prioritisation.**

The five selected IDIA goals will also be used as key themes in the roadmap development and intervention prioritisation phase of the innovation ecosystem review.

Upon completion of the prioritisation process, SWOT analyses were conducted through desktop research and stakeholder engagements to identify the current maturity level of each of the five IDIA goals within the context of the Kenyan space sector. The key findings across each of the IDIA goals were then highlighted and presented along with recommendations for obtaining an ideal ecosystem state in Kenya.

Building Human Capital

The building of informed human capital entails growing the knowledge, capacities, skills, relationships and expertise that enable people to innovate and support innovation processes (IDIA, 2021). The investment in the people, particularly innovators, in the ecosystem is critical.

Access to Finance

Ensuring the accessibility of financing for innovation, as strong entrepreneurial ecosystems need a multifaceted range of financial institutions to provide various financial products and services (IDIA, 2021), as well as through innovative finance mechanisms.

Innovation Culture

Nurturing a culture that is supportive of innovation and entrepreneurship is of foundational importance as it allows for a wide range of contributions which help nurture a positive culture of research feeding into innovation processes and where innovation can flourish (IDIA, 2021).

Networking Assets

Supporting coordinated networking of assets that enable productive collaborations between actors enables the formation of different kinds of networks, including formal, informal, industry, supply chain, geographical clusters, and R&D networks (IDIA, 2021).

Equitable and Inclusive Participation

Ensuring equitable and inclusive ecosystem governance and participation means making certain that a gendered and social inclusion lens is applied in the development of the ecosystem (IDIA, 2021).

One of five levels of maturity was awarded to each of the IDIA goals that anchored the assessment process. A comprehensive criterion was developed for each of the five levels of maturity, to provide a thorough understanding of the ecosystem's current state and ensure that the assessment was conducted consistently across different areas of the ecosystem.

The detailed criteria allowed for:

- A comprehensive evaluation of the ecosystem, covering all relevant aspects such as technology, policy, processes, culture, governance, and partnerships;
- Ensuring that the assessment was objective and based on measurable factors, which would enable the generation of specific, actionable recommendations for improvement; and
- Detailed maturity metrics that were useful for ecosystem benchmarking, which entailed comparisons with other ecosystems and industry standards, to identify where the ecosystem stands relative to peers.

Table 1 below shows a summary of the criteria used across all five IDIA goals in the maturity assessment. A more detailed breakdown of the maturity criteria can be found in **Appendix 5: IDIA Goal Maturity Level Breakdown.**

	Latent	Nascent
Building Human Capital	Limited or no specialised training programmes, infrastructure, collaboration, interest, and government support for human capital development in the sector.	Emerging training programmes, initial infrastructure, early government support, and national networking platforms fostering human capital development in the sector.
Access to Finance	Limited or no access to diverse funding sources, absence of innovative funding options for marginalised groups, low investor risk appetite, and unfavourable policies hindering investment into the sector.	Emergence of diverse and innovative funding sources, and incubators, supporting early-stage start-ups in the country. Growing investor risk appetite, and initial policies supporting investments into the sector.
Innovation Culture	Minimal or no awareness and support for innovation, absence of educational programmes, incentives, dedicated innovation institutions, government policies, and networking opportunities.	Emerging recognition of innovation's significance with national campaigns, introduction of innovation-focused courses, incentives and awards, early-stage institutions, and networking opportunities fostering collaboration among innovators.
Networking Assets	Limited or no formal infrastructure for innovators to network and collaborate, infrequent events, limited platforms, and poor communication channels hindering engagement among key stakeholders.	Emerging networking infrastructure development and dedicated spaces for innovators, a growing number of networking events, platforms, and support programmes, fostering collaboration among stakeholders.
Equitable and Inclusive Participation	Limited or no formal Diversity, Equity and Inclusion (DEI) policies, minimal representation in governance, limited resources, and engagement hindering equity and inclusion in innovation and decision-making.	Emerging DEI policies and representation in governance, growing awareness of DEI, increased resources, and moderate engagement from diverse groups in innovation and decision-making.

	Forming	Establishing
Building Human Capital	Growing government support, active industry-academia collaboration, specialised programmes, innovation hubs, regular networking events, and numerous practical opportunities for students and professionals.	Regionally renowned university programmes, active innovation hubs, government funding, and sustained industry-academia collaboration attracting top talent into the sector, fostering skills development.
Access to Finance	Growing financial ecosystem with diverse and innovative funding sources, several incubators, specialised financial services, active collaboration, high-risk appetite, and strong investment culture.	A robust financial ecosystem with diverse and innovative funding sources, strong collaboration, and supportive investment culture, fostering innovation from ideation to commercialisation.
Innovation Culture	Growing national awareness and support for innovation with tailored courses, substantial incentives and awards, established institutions, and regular networking opportunities, fostering a culture of innovative thinking and integration.	Strong national recognition of innovation's importance, backed by educational programmes, incentives, dedicated institutions, regular networking opportunities, and deep integration into the national culture, facilitated by effective partnerships.
Networking Assets	Growing networking infrastructure and dedicated spaces for collaboration, regular networking events, established platforms, robust communication channels, support programmes, and active collaboration across sectors.	Advanced networking infrastructure, frequent high-quality networking events, sophisticated platforms, effective communication channels, extensive support programmes, and deep collaboration across sectors extending to global participation.
Equitable and Inclusive Participation	Growing DEI policies and awareness, significant representation in governance, broad access to resources, active engagement, and regular monitoring ensuring equity and inclusion in innovation and decision-making.	Comprehensive DEI policies, strong governance representation, extensive resources, high engagement, advanced monitoring, and strong institutional support ensuring equity and inclusion across innovation and decision-making.

	Established
Building Human Capital	Internationally acclaimed university programmes, numerous innovation hubs, continuous influx of talent, supportive government policies, and collaborative industry-academia initiatives driving innovation.
Access to Finance	A competitive financial landscape with diverse and innovative funding, tailored financial services, supportive policies for innovation and risk-taking, and high investment attractiveness driving socioeconomic growth.
Innovation Culture	Well-established national campaigns reinforcing innovation's importance, alongside top-tier educational programmes, widespread incentives, leading innovation institutions and hubs, global collaborations, cultural integration, and effective partnerships.
Networking Assets	World-class infrastructure enabling global collaboration among innovators, top-tier events, exemplary communication platforms, leading support programmes, and impactful global leadership driving sustainable development.
Equitable and Inclusive Participation	Exemplary DEI policies and governance, universal resources, maximum engagement, state-of-the-art DEI monitoring, institutional support, and global leadership driving equitable integration and sustainable development.

Table 1: Summary of the maturity criteria for each of the prioritised IDIA goals

3

STAKEHOLDER CATEGORIES

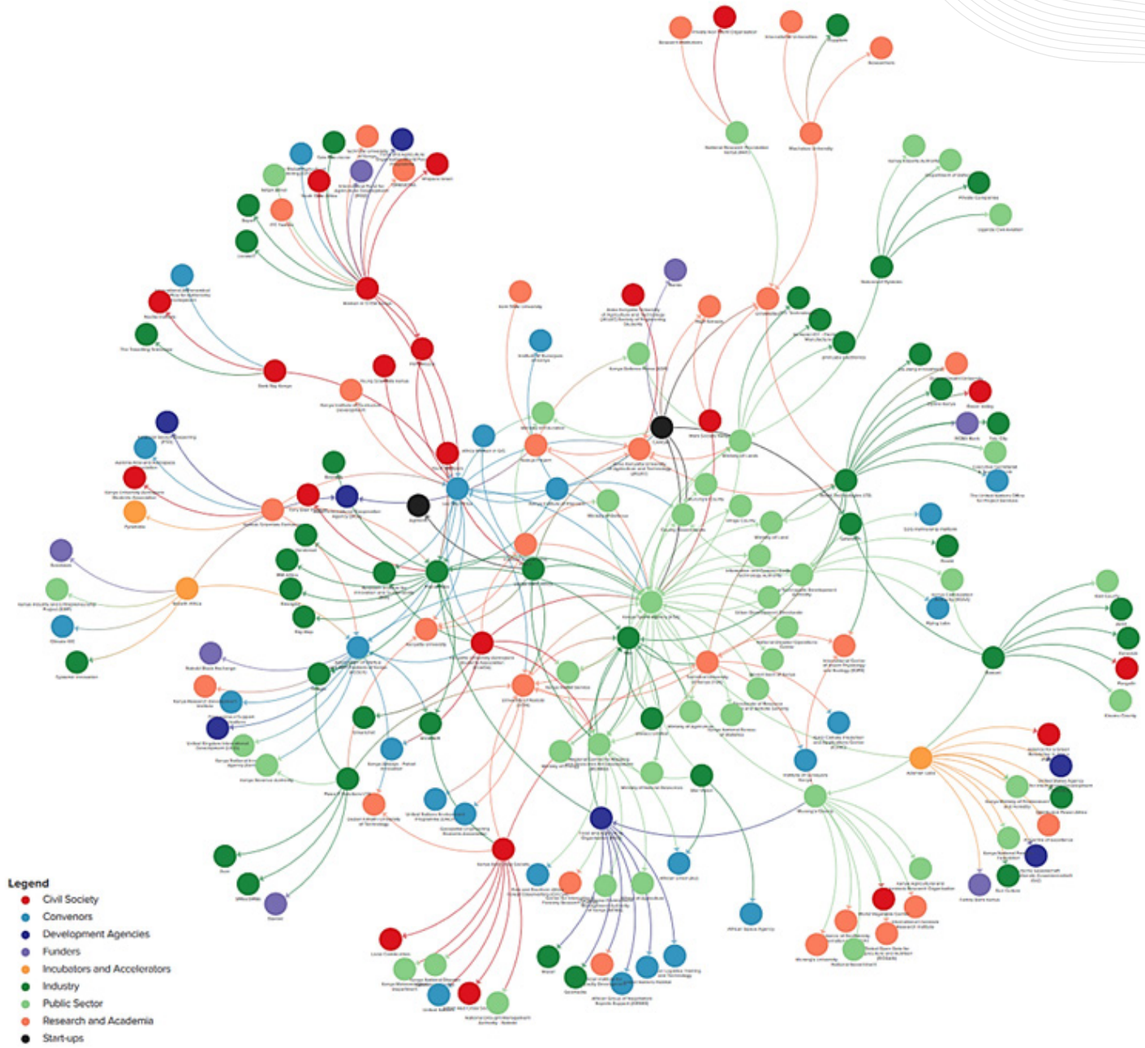
A combination of desktop research and stakeholder engagements were used to complete the assessment. Stakeholders were categorised into nine categories based on their role within the ecosystem, namely: civil society organisations; convenors; development agencies; funders; incubators and accelerators; industry; public sector; research and academia; and start-ups. A concerted effort was made to engage with individuals from each category to ensure a robust assessment. Table 2 below provides descriptions for each of the nine stakeholder categories used in the analysis along with examples from each category.

Stakeholder Categorisation	Description	Examples
Public Sector	A government-owned or government-controlled entity responsible for providing goods or services to the public.	Kenya Space Agency, Kenya Innovation Agency
Research & Academia	Dedicated to the investigation, study, and dissemination of knowledge in the form of research outputs, intellectual property, proofs of concept and prototypes.	Jomo Kenyatta University of Agriculture, University of Nairobi
Industry	A sector of economic activity involving the production or provision of goods and services for commercial gain.	LocateIT LTD, SayariLabs, ESRI Eastern Africa
Convenors	An individual or entity responsible for organising and facilitating discussions, meetings, or events among stakeholders with diverse interests to achieve a common goal.	Kibera Aeronautics and Space Academy (KASA)
Civil Society Organisations	Encompasses diverse non-governmental organisations (NGOs), community groups, and voluntary associations independent of the government and the private sector, working collectively to promote shared interests.	Geospatial Society of Kenya
Development Agencies	Organisations, often governmental or NPOs, dedicated to promoting economic, social, and environmental progress in regions or countries through initiatives such as aid programmes and capacity building aimed at addressing sustainable development goals.	UN Development Programme, USAID
Funders	Entities or individuals providing financial support, resources, or grants to initiatives, projects, or organisations to enable their operations, for growth, or for specific activities.	Africa Development Bank, Venture Capital firms
Start-ups	Newly established businesses or ventures, typically innovative and technology-driven, aiming to address specific market needs or disrupt existing industries, often characterised by rapid growth, experimentation, and a focus on scalability.	AgriBora, Spatiality Limited
Incubators & Accelerators	Organisations designed to support the growth and development of early-stage start-ups and entrepreneurs by providing resources, mentorship, networking opportunities, and sometimes funding, with the goal of accelerating their progress, refining their business models, and increasing their chances of market success.	MBM Africa, The Baobab Network, ihub

Table 2: Nine stakeholder categories

A Kenyan space ecosystem stakeholder map was created collaboratively between various ecosystem actors, using these nine categories. Figure 2 below shows the outcome of the collaborative stakeholder mapping activity.

Note that this map should not be taken as a comprehensive stakeholder map of the Kenyan space innovation ecosystem as it is only representative of stakeholders from whom responses could be gathered. However, this map offers a concise snapshot of how various stakeholders within the ecosystem are connected.



CLICK HERE TO INTERACT WITH THE MAP

Figure 2: Stakeholder Map of Kenyan Space Innovation Ecosystem created collaboratively with ecosystem stakeholders.

4

KENYAN SPACE VALUE CHAIN

According to the Organisation for Economic Cooperation and Development (OECD, 2022), the modern space economy consists of ***"all private and public actors involved in developing, providing and using space-related products and services".***

The US Bureau of Economic Analysis (BEA, 2020) defines space-related goods and services as:

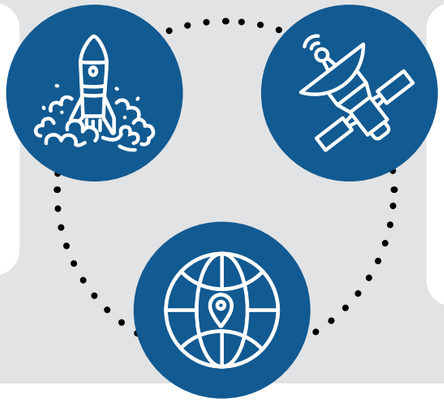
i. Goods and services which are used in space, or directly support those used in space; and

ii. Goods and services that require direct input from space to function, or directly support those that do.

Considering the definitions above, the space value chain can be classified into three main segments which broadly covers both the space infrastructure and space services industries:

The **Upstream or space manufacturing sector** produces and supplies various components of space infrastructure which enable downstream activities (OECD, 2022). This segment supplies the space economy with three main types of space assets:

Launch systems – including launch vehicles (rockets) that place spacecraft into orbit, and the associated launcher platforms with fuelling stations;



Spacecraft systems – such as satellites and satellite sub-components that conduct various space missions, mainly remote sensing, earth observations, navigation and communications;

Ground systems – includes telemetry and tracking stations as well as production facilities that conduct assembly, integration and testing of communication antennas, spacecraft components. Also included are launch vehicles and ground-based observatories which are used to conduct fundamental research in the areas of space science and astronomy.

The Upstream segment also includes space activities involving basic research and development of space and ground systems.

The **Midstream or space operations sector** purchases and operates the space infrastructure produced from the Upstream segment and provides value-added outputs either as public goods or services or for commercial gain. This segment includes military and civilian space agencies, e.g., NASA; ISRO; ESA etc, commercial spacecraft operators e.g., Eutelsat; Arabsat; etc, and launch operators e.g., SpaceX; Blue Origin; etc. The Midstream represents the link between the Upstream and the Downstream segments of the value chain.

The **Downstream or space applications sector** represents the space applications industry which leverages outputs from the Upstream and Midstream as an input to produce new products and services for specific applications (e.g., geolocation apps) or to enhance businesses (e.g., the use of Earth Observation data for agricultural monitoring, disaster management, etc.) Governments, the private sector and all institutions and individuals using space-enabled products and services form part of the downstream sector.

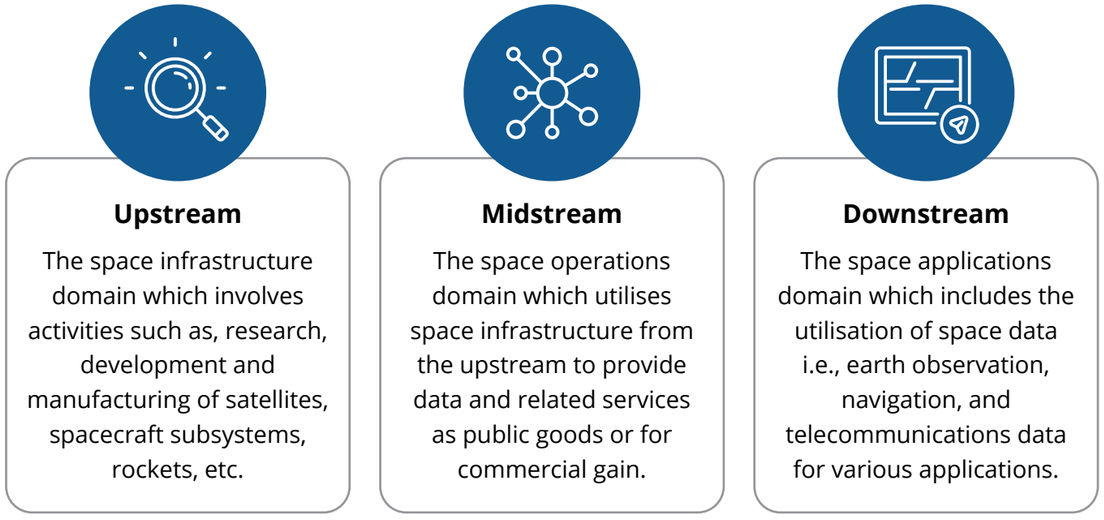


Figure 3: Overview of the three main segments of the space value chain

Within the Kenyan space ecosystem, key activities, initiatives and programmes exist throughout the value chain. Some of these activities are presented in Table 3 below along with a few examples of the key stakeholders and notable partnerships in each segment of the value chain.

	Key sector activities and developments
Upstream (Infrastructure) 	• The Luigi Broglio Space Centre in Malindi operated as a satellite launch site from 1967 to 1988 and now serves as a ground station for telemetry tracking, control services, and providing scientific data. It is hosted in cooperation with the Italian Space Agency (ASI, 2022). • In April 2023, Kenya launched its first operational Earth Observation satellite, Taifa-1, which was built in collaboration with Endurosat in Bulgaria, with a ground station in Kasarani commissioned to support data reception from the mission (Nation, 2023). • Kenya is one of numerous African partner countries involved in the Square Kilometre Array (SKA) project and is contributing to the project by offering strategic locations for (SKA) mid-frequency dishes (Beeline, 2018). • Kenya continues to expand its space weather monitoring network nationwide (Njeri, 2023). • The Kenyan Space Agency plans to establish a new spaceport to restore its launch capabilities. • Initial planning is being done in collaboration with the UK Research and Innovation and UK Astronomy Technology Centre (UK ATC) on the building of a world-class astronomical observatory in Kenya (UKGCRF, 2019). • In partnership with Egypt and Uganda, Kenya is developing the ClimCam satellite to monitor weather, floods, and climate change (Faleti, 2021). • The Africa Development Satellite Initiative (Af-dev Sat) aims to create a 6U Earth Observation CubeSat for climate change monitoring and mitigation (Iraqi, 2021).
Midstream (Operations) 	• The Kenyan Space Agency coordinates all space-related activities in the country and builds partnerships with various other space agencies (for example, the South African National Space Agency, the Indian Space Research Organisation and Japanese Aerospace Exploration Agency). • The Regional Centre for Mapping and Resources for Development (RCMRD), facilitates the creation, dissemination, and application of geospatial data for various sectors such as agriculture, water resources management, environmental monitoring, etc. • Digital Earth Africa is an industry player that primarily provides access to analysis-ready space data and analytical tools that can be used by governments, researchers, NGOs, and other stakeholders for multiple use cases. • Other private sector organisations like ESRI, Maxar, Planet Labs and Spatial Collective provide satellite data, GIS and mapping services to facilitate downstream applications. • The Kenya Agricultural and Livestock Research Organisation (KALRO) has developed a data cube for processing EO data on agriculture and water conservation (RCMRD, 2023).
Downstream (Applications) 	• The Kenyan Ministry of Environment, Climate Change and Forestry along with the Kenya Meteorological Department (KMD) uses satellite data for weather forecasting, climate monitoring, and early warning systems for natural disasters. • The Ministry of Agriculture employs satellite data to monitor crop health, forecast agricultural yields, and manage food security (Poteet, 2021). • The Kenyan Red Cross Society utilises satellite imagery to monitor the impacts of floods across different areas (SiA, 2021). • LocateIT Ltd provides Geo-ICT solutions for land degradation monitoring and is working on AI solutions for the health sector (RCMRD, 2023). • TomorrowNow is a climate-tech non-profit that leverages space data to develop weather intelligence solutions to support farmers and vulnerable communities in Kenya. • Agribora is an agri-fin-tech company that uses earth observation data to support smallholder farmers improve farming productivity and conduct agribusiness in a more cost effective and productive way.

Table 3: Summary of the key sector activities and developments across the Kenyan space value chain

4.1. SWOT ANALYSES

The initial contextual research allowed for a broad understanding of the current state of the Kenya ecosystem which extended beyond just the space sector. The findings from the contextual research were then used to guide the investigation of various internal and external factors that could affect the state of the Kenyan innovation ecosystem and particularly the space sector. The factors were presented in a SWOT analysis for each of the prioritised IDIA goals.

The factors presented were prioritised based on impact and relevance in accordance with the maturity criteria presented in **Appendix 5: IDIA Goal Maturity Level Breakdown.** As an addition to the maturity assessment of the IDIA goals, stakeholders who play an active role within each IDIA goal were identified, and then further categorised into one of the nine stakeholder categories.

Efforts to build human capital in the Kenyan space ecosystem are increasing, but closer collaboration with academic institutions is required for optimal growth.

BUILDING HUMAN CAPITAL

Maturity Level: Forming

STRENGHTS

Several public and private organisations (e.g. Kenyatta University, KSA etc.) are **actively providing training support and skills development** (i.e., university courses and programmes, Global Learning and Observation to Benefit the Environment [GLOBE]).

To nurture and grow interest and knowledge base in the space sector, KSA has a Space Club for STEM learning at primary and secondary level, and space opportunities at tertiary level (e.g. internships, attachments, space weather programmes, volunteer work at Space Club events, funding support for innovative ideas, launch site visits, etc.) (Kenya Space Agency, 2024).

To enhance technical skills and build capacity, KSA has launched Research Chairs on Operational Space Weather and Nanosatellite Development (Funds Beeline, 2020).

There is an **entrepreneurial drive and culture** to start a business that uses space-based solutions innovatively (e.g. many Agri-tech start-ups applying space-based applications such as drones, GPS, etc, to adjacent sectors like agriculture). The Agri-tech is the second biggest sector for job creation (The Kenyan Startup Ecosystem Report, 2022).

OPPORTUNITIES

Conduct a **skills audit** for key space sector areas (e.g., engineering, aeronautical, meteorology, etc.) to inform on gaps and skills in the space in Kenya.

Highlight **career growth areas** (i.e., in space technology, space weather, aerospace engineering, data analysis and geospatial intelligence, nanosatellite development, etc.) **and opportunities** in the space sector to inspire students to pursue related courses and inform the public about the field's benefits.

Leverage technological advancements **to create innovative training and upskilling programmes for online learning and skills development.**

Leverage KSA **existing regional and international cooperation initiatives** (i.e., Kenyan universities; JAXA) for capacity building.

Opportunity for **universities to focus on sector-relevant skills.**

Build **stronger partnerships** between academia and the space industry.

Utilise existing incubators and accelerators in Kenya for **space-focused knowledge sharing, training and mentoring.**

Leverage **Centre of Excellence in Electronics and Space Science** to be established through EAC Vision 2050.

WEAKNESSES

Misalignment between tertiary education and industry specialised skill needs (e.g., Machine Learning, coding, Microsoft software, Remote Sensing, GIS and surveying skills, etc.) leads to an **industry skills gap.**

Shortage of skilled workforce specific to the space sector, in most areas, due to low technical capacity.

Limited public-private partnerships (i.e., specifically industries and academia) in the provision of skills development through internships and attachments.

THREATS

Reskilling and upskilling the workforce is expensive due to the rapid technological advancements which hinders uptake of skilled workforce from adjacent sectors.

The limited opportunities in the sector can deter the interest of skilled labour and result in brain drain on a national scale.

Economic downturns can reduce government funding for space sector skills development plans.

Talent retention is low due to availability of global training, jobs and skills development opportunities in the sector.

BUILDING HUMAN CAPITAL

Figure 4: Stakeholder map for building human capital

BUILDING HUMAN CAPITAL

Key points pertaining to the current state of the ecosystem according to stakeholders:

- The significant role of industry in building human capital has also been highlighted by many stakeholders indicating a need for different types of stakeholders to work together to develop future capacity.
- It was also noted that capacity-building initiatives have been occurring on multiple levels, and are not only focussed on tertiary students or those in industry, which is promising for the future of the sector.
- The skill set required to develop a vibrant space ecosystem involves multiple disciplines. However, in certain space disciplines, such as Geographic Information Systems (GIS), there is an abundance of expertise in Kenya, with local talent being competitive on a global scale.
- Despite this, there is room for better alignment between the skills and technology being taught in universities and the needs of the industry. To address this, various programmes such as industry attachments, internships and on-the-job training aim to bridge the gap between academic offerings and industry requirements.

Kenya has a healthy flow of capital into tech start-ups and downstream space applications, in addition to a growing number of innovative funding mechanisms facilitated through blockchain technology.

ACCESS TO FINANCE

Maturity Level: Forming

STRENGHTS

Kenya is **one of the largest beneficiaries of FDI in Africa.** According to the UNCTAD, World Investment Report 2023, FDI flows to the country were estimated at 759 million USD (UNCTAD, 2023). Kenya's **major recipient sectors** of FDI are **manufacturing, financial services and information and communication technology which all feed into the space sector** (Mose, 2024).

According to Disrupt Africa's 2023 report, **Kenya registered the highest tech start-up funding in 2022** among all African countries at **674 million USD of funding raised** (DA, The African Tech Startups Funding Report, 2023).

Many venture capital firms in Kenya invest in tech start-ups that already use, or have the potential to use, **space data** in their solutions (DA, The Kenyan Startup Ecosystem Report , 2022).

WEAKNESSES

Most **upstream space activities** in Kenya have **failed to gain significant traction** because they are **capital-intensive**, with **high gestation periods and high-risk of failure or low return on investment.**

Currently, there are challenges around **collateral requirements and unfavourable banking policies,** that are **disadvantageous for female-entrepreneurs attempting to raise start-up capital** (Aljazeera, 2020).

There is still **limited private sector participation, i.e., funding from industry** to support innovation in the space sector in Kenya, although there is some evidence of steady growth.

OPPORTUNITIES

Kenya's **geographical advantage as an equatorial country,** makes it an attractive destination for **establishing a spaceport** and could be leveraged to **attract local and foreign investments into enterprises providing launch and tracking services.**

A growing **adoption of blockchain technology has allowed for more innovative funding mechanisms** (e.g. peer-peer lending, tokenization etc.) to take shape allowing for more inclusive access to finance (TiA, 2018).

Improvement in digital access to finance for women-led SMMEs in Kenya through the World Bank's Women Entrepreneurs Finance Initiative (WEFI) could see a rise in female-led businesses within the space sector.

Kenya's **regional integration through membership with the East African Community (EAC) and the African Union (AU) can be leveraged to access larger markets,** enhance Kenya's international profile and **attract foreign investment** (Maurer, 2023).

THREATS

Geopolitical factors can negatively influence access to external funding into the Kenyan space sector. This could include regional instability (i.e. neighbouring countries experiencing political tension which may spill over to Kenya) and domestic disputes around governance issues, could deter foreign investment (Blanshe, 2024).

Global economic trends such as commodity prices, interest rates, and investor sentiment can affect Kenya's ability to **attract foreign investment** (Foust, 2022).

Limited public sector funding (i.e. a declining space sector budget) can stunt the growth of new and innovative space initiatives.

Many space infrastructure projects require **long term continuous investment** cycles; however, current funding practices may only consider short-term projects where results are clear and measurable.

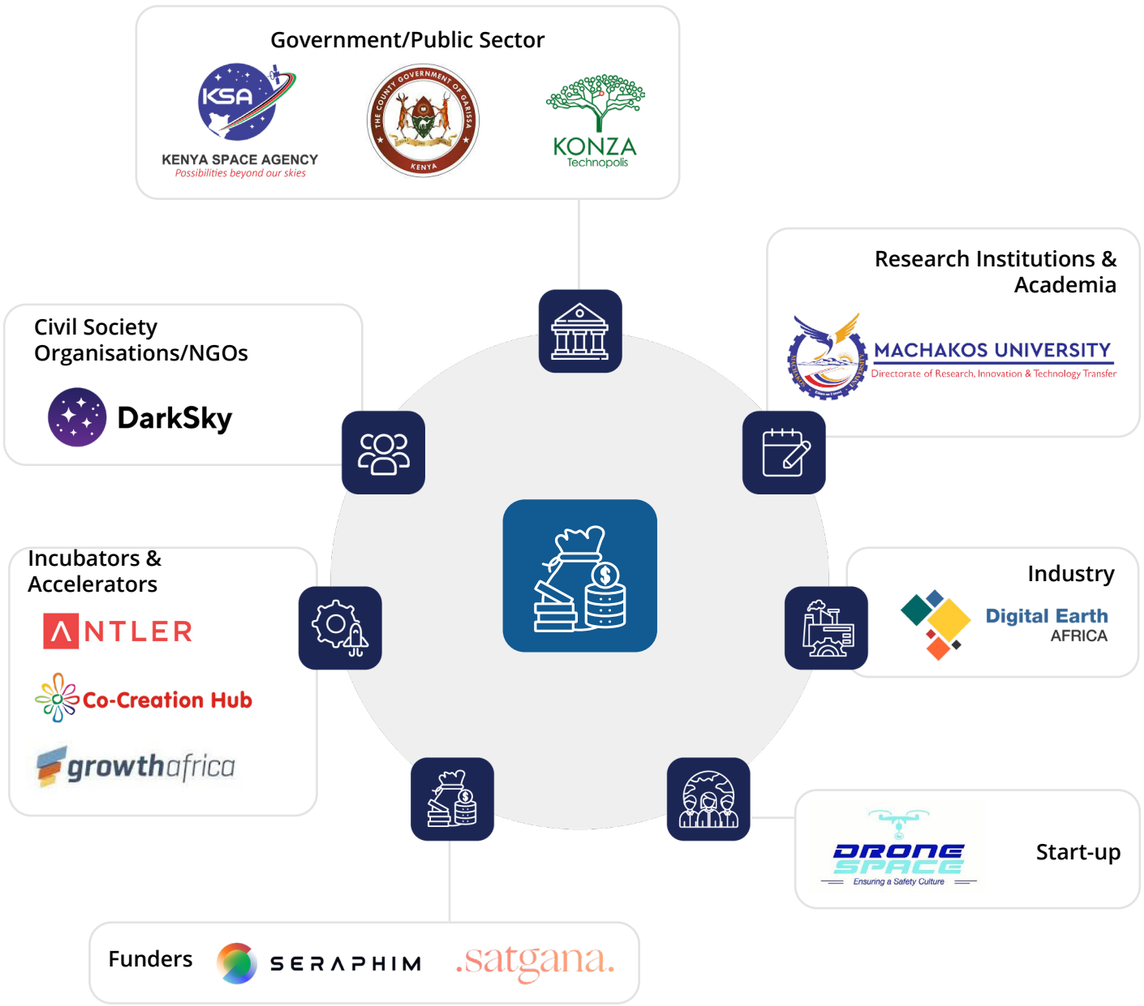


Figure 5: Stakeholder mapping for access to finance

ACCESS TO FINANCE

Key points pertaining to the current state of the ecosystem according to stakeholders:

- Kenya is one of the leading destinations for international investment in Africa; however, a lack of awareness among funders about the opportunities and solutions provided by space technology hinders their participation in this market.
- A prominent investor, active in the African technology space, indicated that a “proof of concept would make them fund a space innovation” necessitating funding in this regard.
- “Proof of concept would encourage funding for space innovations.
- While grant funding is available, it is often attached to developing solutions based on specific technologies, such as satellite data, rather than supporting broader business models.
- Additionally, local start-ups do not fare as well as their international counterparts, not on business merit, but as a result of poorly communicating their business propositions.

Kenya is experiencing a growing space innovation culture through collaborative regional initiatives and hosting innovation-focused programmes and conferences

INNOVATION CULTURE

Maturity Level: Forming

STRENGHTS

Kenya is a **regional leader in digital readiness**- implying that majority of the populace, particularly the youth, are willing to adopt and benefit from digital technologies (Kaberia, 2024).

The country has a **variety of universities with specialised technology and innovation-focused programmes** (for e.g. The Jomo Kenyatta University of Agriculture and Technology).

The annual **Kenya Space Expo** and conference has been a major networking event that has **attracted an international audience** and has contributed towards building national awareness on the benefits of space technologies and applications in Kenya's socio-economic development (KSA, Kenya Space Expo Conference 2022 report, 2022).

Collaborations with other countries in the region on flagship space projects have facilitated the adoption of new ideas, processes and technologies through tech transfer, for example, the Af-Dev Sat programme (Kalil, 2021).

WEAKNESSES

Despite the awareness raising efforts in place, **space is still not mainstream in Kenya,** and **entrepreneurs in other sectors are not fully aware** of the potential **innovative use cases for space data** in their solutions, leading to a **limited adoption of space technologies** among tech start-ups.

According to the **Global Innovation Index (GII) 2023,** which ranks economies by their capacity for, and success in innovation, **Kenya ranked 8th in the African region** lagging other big African economies in terms of having **a strong innovation culture.**

Prominent convenors like the **Space Generation Advisory Council (SGAC),** are **not being fully leveraged to promote space technology,** research and innovation in the country particularly amongst the youth.

OPPORTUNITIES

The existing innovation policy and institutional framework can be **reformed to be more "innovator friendly"** and provide a more **enabling environment** for innovation to flourish (KTN-UK, 2021).

Hosting of entrepreneurial challenges focused on space technology solutions, for e.g. the Africa EO Challenge, in Kenya can position Kenya as a regional champion for space innovation and facilitate an entrepreneurial culture to drive entrepreneurial skills development locally.

The formation of a **Space Sector Advisory Committee,** composed of professionals and key stakeholders, can allow for flagship space programmes to be conducted in a coordinated and synergistic manner leading to greater efficiency and impact (KSA, Space Sector Stakeholders Forum, 2021)

Emergence of Konza Technopolis (smart city) as a world-class technology hub has potential to integrate satellite data and raise awareness of the benefits and use cases of space data and boost Kenya's innovation capacity.

THREATS

Unfavorable start-up compliance policies, stringent due diligence requirements and bureaucratic barriers may hinder entrepreneurship and innovation in the Kenyan space industry.

Fragmentation of the ecosystem whereby innovation actors are siloed, can create a situation where there is a **lack of cross-sectoral or cross-societal cohesion.**

An estimated **97.4% of technology start-ups are concentrated in Nairobi.** This, in conjunction with a **low literacy rate in rural areas,** could lead to a **digital divide** in the country between rural and urban areas (DA, The Kenyan Startup Ecosystem Report, 2022).

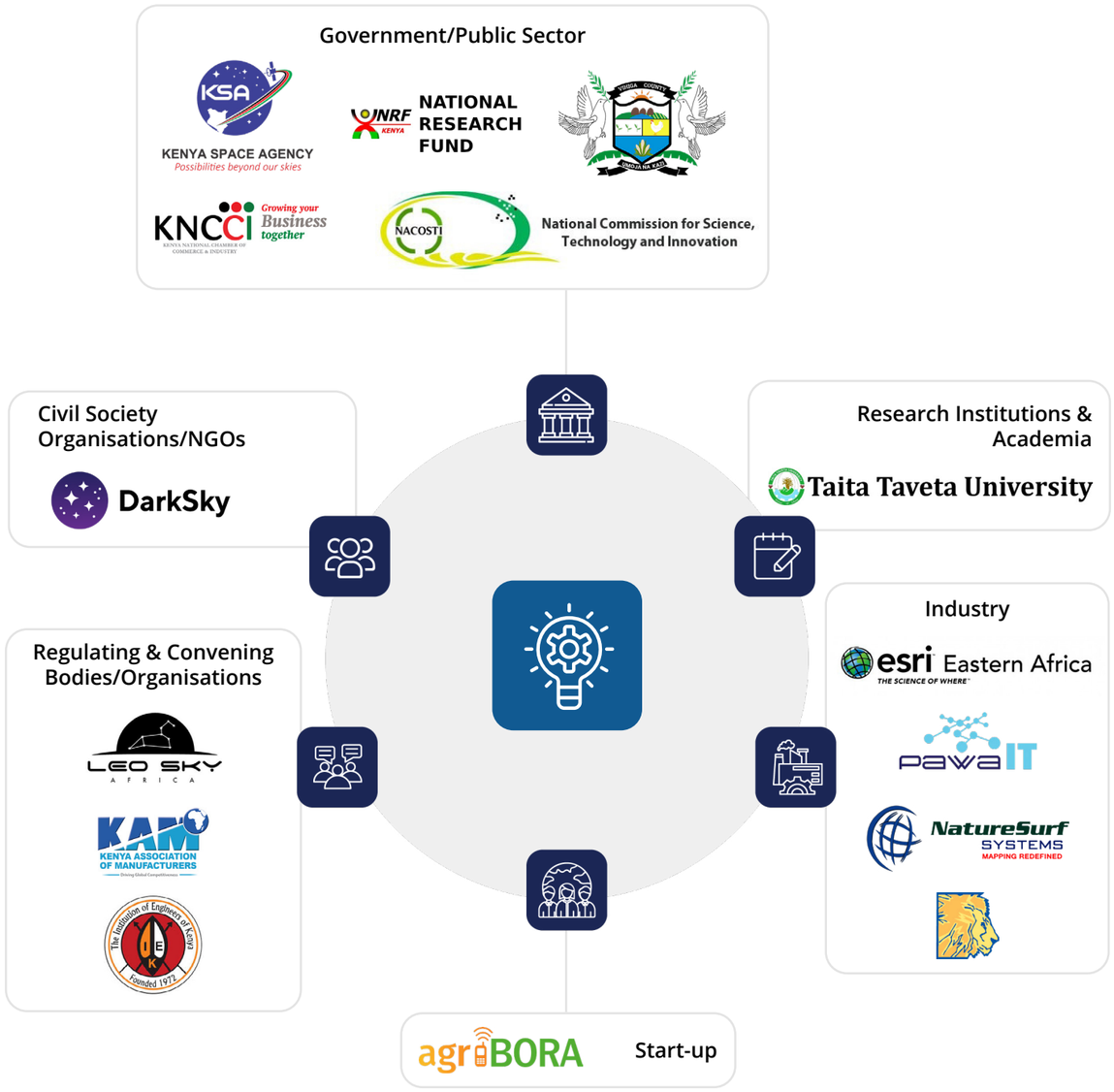


Figure 6: Stakeholder mapping for innovation culture

Key points pertaining to the current state of the ecosystem according to stakeholders:

- According to a youth-owned start-up, there is a “willingness from young people” to adopt innovations in Kenya, who can use this technology to achieve their goals.
- There are also efforts to foster a culture of innovation from multiple stakeholder groupings, such as universities who are hosting space clubs. These efforts broaden the innovation mindsets of individuals by piquing curiosity in the space sector.
- Critical research, an example of such an effort, can be enhanced by incorporating aspects of space into current academic programmes to increase awareness.
- Efforts to improve the perception of space are also occurring at various educational levels and through community outreach programmes.
- Novel use cases of space technology in wildlife conservation and urban planning are emerging from institutions not traditionally known for innovation, such as county governments and conservation organisations.
- According to a senior town planner, *“Kenya is not innovative in how it produces data but demonstrated innovativeness in the consumption of data”* – indicating that a strength of the Kenyan ecosystem is in its ability to leverage data in innovative ways rather than generating its own data.
- Additionally, it was mentioned by a civil society organisation that supportive policy frameworks for specific sub-sectors in space, such as exploration, are required to support ongoing innovation.

Kenya has made significant effort to invest in developing its networking assets in the space sector, however there are plenty of opportunities for further development

NETWORKING ASSETS

Maturity Level: Establishing

STRENGHTS

National space **policies and strategies encourage networking and collaboration within the sector.**

Presence of reputable institutions like the University of Nairobi and Technical University of Kenya, which foster research and development in space technology, serve as **hubs for networking among academics, researchers, and industry professionals.**

Participation in global space initiatives and forums **facilitate networking with global leaders and experts.**

Kenya can **continue providing networking opportunities,** such as hosting regional space conferences, expos and forums, such as the Kenya Space Expo and Conference 2024, which can attract participants from across Africa and beyond.

WEAKNESSES

A **shortage of highly specialised professionals** in the space sector **limits effective networking and knowledge exchange.** This may lead to limited local capacity for advanced research and development activities.

Insufficient funding hampers the ability to participate in international conferences, workshops, and other networking events.

OPPORTUNITIES

Investment in space education and training programmes can enhance local expertise, creating a more vibrant networking environment. Establishing mentorship and internship programmes can connect students and young professionals with industry leaders.

Development of technology and innovation hubs focused on space technology can foster networking among start-ups, researchers, and investors. These hubs can serve as incubators for new ideas and collaborations.

Create platforms for networking among entrepreneurs, investors, and other stakeholders in the space sector.

Bringing together the different stakeholders by creating a Community of Practice, like the National Group on Earth Observation and its Communities of Practice (CoPs), can facilitate rapid uptake of Earth observation data to support informed decision-making and policy development related to key societal challenges (RCMRD, 2023).

THREATS

Economic downturns can reduce government funding for networking activities and **limit participation** in international events. Financial constraints impact the sustainability of local networking initiatives.

Global competition can overshadow Kenya's networking efforts and opportunities.

Figure 7: Stakeholder mapping for networking assets

NETWORKING ASSETS

Key points pertaining to the current state of the ecosystem according to stakeholders:

- Kenya is emerging as a regional hub for the space industry and there are a number of international collaborative efforts occurring in the ecosystem pertaining to training, funding, operations, knowledge transfer and research with local collaborations mainly focusing on operations and research.
- Despite being part of the East African Community (EAC), it is predominantly international companies that leverage the opportunity to sell across the region.
- There is also a presence of convening bodies within the sector such as Leo Sky Africa whose focus is solely on space as well as others whose focus is not solely on space, such as the Institute of Engineers and Institute of Surveyors Kenya, but can be leveraged by the space sector.
- Networking events such as conferences, research festivals and space education events were highlighted as those that tend to bring together the different types of stakeholders in the ecosystem.

Increased efforts towards equitable and inclusive participation of women and youth have the potential to support the growth of the space sector further

EQUITABLE & INCLUSIVE PARTICIPATION

Maturity Level: Nascent

STRENGHTS

Kenya has **many national policies in place that enable gender-diversity and participation of marginalised groups** (e.g. the National Policy on Gender and Development).

KSA Gender Mainstreaming Policy (2020) is aimed at guiding gender equality and equity in KSA, the country's leading corporation for all space-related activities (Kenya Space Agency, 2020).

Gender parity and representation of women already achieved within KSA (e.g. appointment of women as board members and management positions) (Kenya Space Agency, 2020).

Growing number of influential female role models in the Kenya space sector.

KSA **encourages participation of marginalised groups through some of its initiatives** (e.g. hosting Space4Women in 2024; hosting Kenya Space Expo and Conference, Career fair, space-focused public gatherings, etc.).

WEAKNESSES

Limited access and meaningful participation of marginalised groups in the space sector due to restricted finance and resource availability, lack of specialised skills, socio-economic challenges, etc. For example, 7,8 million Kenyans in 2024 live in poverty (Statista, 2024).

Limited supply of jobs due to increase in demand as there are more graduates than jobs available. This leads to under utilisation of youthful talent and perspectives into the space sector (e.g. Over half of Kenya's 1.54 million unemployed are aged 20 to 29, highlighting a youth unemployment crisis (The East African, 2023).

Current national policies to support increased access of marginalised groups is **ineffective in achieving its outcomes.** For e.g., only 6% out of 96% of Kenya's rural women population working on farms hold a title to land. (Kenyatta, 2023; Oxfam International, 2024).

Statutory, customary and religious laws and practices that support a patriarchal social order **infringe on gender equality.**

OPPORTUNITIES

Increase in existing practices of the constitution pertaining to representation of women in leadership positions (e.g. one women representative for every 47 counties in Kenya; first female commander appointed in the Kenya air force in 2024).

Encourage participation from marginalised groups through **ringfencing funding and similar initiatives** in the space sector, to help increase diversity and inclusion in the space sector.

Improve monitoring and evaluation mechanisms that track policy implementation and their outcomes (i.e., Gender Mainstreaming Policy).

Increase inclusion of marginalised group perspectives through **collaborations and partnerships with community-based organisations** that are youth or women-centered, which can assist in the development of holistic and impactful space solutions. This would also raise awareness on the space sector's value proposition and potential for social impact.

THREATS

Difficulties associated with addressing the country's main structural barriers, such as poverty lack of education, uneven access to resources and retrogressive cultures, will further exacerbate gender inequalities. This limits participation of marginalised group both in the space and other adjacent sectors.

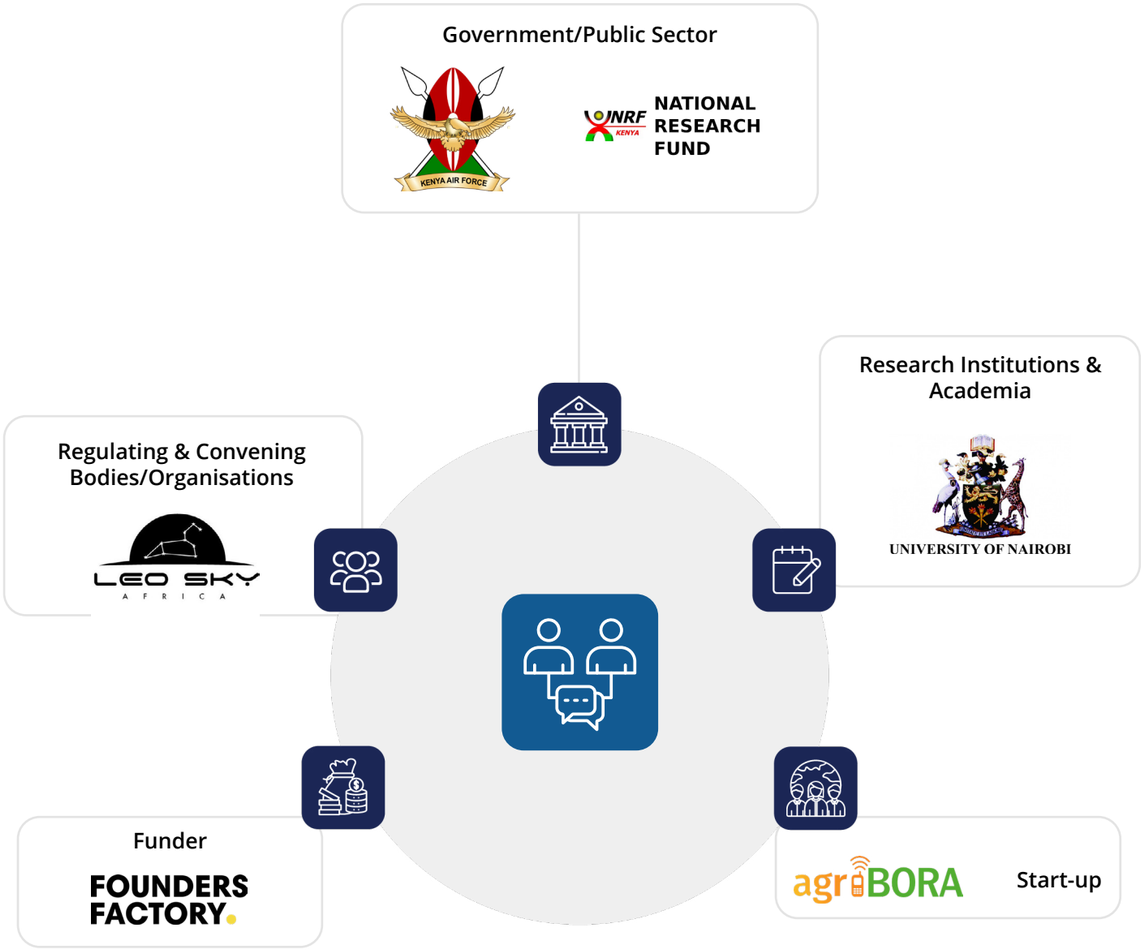


Figure 8: Stakeholder mapping for equitable and inclusive participation

EQUITABLE & INCLUSIVE PARTICIPATION

Key points pertaining to the current state of the ecosystem according to stakeholders:

- In Kenya, there are a number of well-known female-led (at CEO level) space companies such as Viwanda and Amini, providing inspiring role models for future generations.
- Additionally, private companies, in conjunction with the Kenya Space Agency (KSA), organise programmes aimed at introducing the youth to the space industry and demonstrating it as an exciting and promising field for their future careers.
- In terms of marginalised groups, visibility is key to advancing equitable and inclusive participation. The space sector is also starting to make strides in rural areas through the increasing use of space technology in the Agricultural sector.

4.1.1. Assessment Key Findings

Table 4 below shows some of the key findings obtained from the SWOT analyses, including a summary of the maturity rating for each of the five prioritised IDIA goals. Notably, the assessment found that the continued efforts of growing networking assets, has the potential to unlock other innovation strengthening nodes in the Kenyan space innovation ecosystem.

IDIA GOAL	Key Findings	Maturity Level
Building Human Capital	• The Kenyan space ecosystem has demonstrated considerable effort in building a highly skilled workforce by investing in education and outreach, training and skills development initiatives (e.g., Space Club, Moon Village and, Real World Design Challenge) (Kenya Space Agency, 2024). • Public and private sector institutions, such as Technical University of Kenya, University of Nairobi, Kenyatta University, KSA etc, are increasingly providing STEM and space-related training and skills development programmes, outreach gatherings, mentorship, etc. • Despite these efforts and initiatives, Kenya is still faced with a skills gap due to the misalignment of industry specialised skill needs (i.e., Machine Learning, coding, Microsoft software, Remote Sensing, etc) and curricula taught at tertiary institutions. • There is also a push to conduct a skills audit of key space sector areas (i.e., engineering, aeronautical and meteorology) to identify and inform on gaps and skills in the country.	
Access to Finance	• Kenya has witnessed appreciable investment into technology and innovation through various streams like FDI and venture capital. According to Disrupt Africa's 2023 report, Kenya registered the highest tech start-up funding among all African countries in 2022 at 674 million USD of funding raised. • Blockchain technology has enabled the potential for more diverse funding mechanisms for space start-ups to take shape. • While funding for downstream activities is abundant, upstream activities lack funding as they are more expensive and bear more risk. • There is potential to attract more finances for upstream activities (particularly launch activities) due to Kenya's favourable equatorial location. • Initiatives like Women Entrepreneurs Finance Initiative (WEFI) promote the financial inclusion of women-led SMMEs facilitating diverse participation in the sector.	
Innovation Culture	• Kenya has a youthful population with a drive for innovating and including innovation in their everyday life. However, convening organisations like the Space Generation Advisory Council (SGAC) can play a more significant role in mobilising the youth to play a more active role in the local space sector. • Organisations like the Kenya National Innovation Agency (KeNIA) and RCMRD facilitate regional collaboration and provide platforms for growing innovation (For example the Geohub incubator at RCMRD). • Hosting regional open innovation programmes such as the Africa Earth Observation Challenge can position Kenya as a regional leader in driving the growth of a pan-African space innovation ecosystem and can facilitate a robust innovation and entrepreneurial culture in the country.	
Networking Assets	• Academic Institutions such as the University of Nairobi and the Technical University of Kenya serve as hubs for networking among academics, researchers, and industry professionals. • An increase in events that bring together key space sector stakeholders (e.g., Kenya Space Expo and Conference) will increase the potential of more formal gatherings of space actors. • Re-establishing partnerships with international space agencies such as ASI, ESA, and JAXA, as well as participation in global space initiatives and forums, provide networking opportunities with global space leaders and experts.	
Equitable and Inclusive Participation	• Kenyan policies and regulations (e.g., National Policy on Gender and Development; Gender Mainstreaming Policy, etc) are positioned to facilitate a more inclusive and equitable participation environment. • It is reported that marginalised groups (i.e., women, people with disabilities, minority groups and people with lower socio-economic status) find it difficult to access the industry, sometimes due to high entry barriers, restricted finance and resource availability, a lack of specialised skills, socio-economic challenges, etc.	

LEGEND:

Table 4: Key assessment findings and maturity level rating for the five prioritised IDIA goals.

In addition to the in-depth analysis conducted on the five (out of the 9) prioritised IDIA goals, a high-level assessment was also conducted on the remaining four IDIA goals which further validated Kenya's overall rating as a forming space innovation ecosystem. Table 5 below highlights some of the key findings obtained for the remaining IDIA goals.

IDIA GOAL	Key Findings	Maturity Level
Supportive Markets and Infrastructure	• Government is aware of the need to enable increased access to markets, to support competition and allow for the industry to grow. • The Kenyan space private sector is still emerging, with several organisations and satellite companies beginning to establish themselves in the space industry (e.g., Safaricom, Agani Ltd, MySat Africa, etc.) • There is a need for pro-business regulations to nurture entrepreneurship and ease industry (i.e., start-ups and Micro, Small and Medium Enterprises [MSME's]) access to space markets. • Base infrastructure to support the space ecosystem exists but is insufficient (e.g., lack reliable access to electricity and the digital divide between rural and urban areas). Addressing these shortcomings is crucial for supporting the growth of the space sector. • Stakeholders operating within the sector have highlighted the need for better dissemination and accessibility of data, along with better data quality and security. This can be achieved through the formation of a dedicated Data Working Group (KSA, Space Sector Stakeholders Forum, 2021). • Moreover, in addition to existing infrastructure, stakeholders have emphasised the importance having further requisite infrastructure to support the sector's growth, including the need for GIS and Remote Sensing labs, a satellite development facility, GNSS receivers, magnetometers, and optical fibre connectivity to name a few (KSA, Space Sector Stakeholders Forum, 2021).	
Policies & Regulation	• Kenya's policies and regulations (e.g., Kenya Space Policy 2015, Kenya Space Agency Act 2017, Kenya Space Strategy, and Kenya Space Bill 2024) and international agreements and treaties (e.g., African Resource and environmental Management satellite Constellation (ARMC) initiative, the African Leadership Conference (ALC) on Space Science Technology for Sustainable Development, etc) guide the strategic utilisation, management, and exploitation of space resources. • They enable collaboration and participation between various influential actors (e.g., government, academia, private organisations) and from different levels of governance (i.e., local and national). • Kenya has a robust data governance framework that applies broadly to all sectors, including the Data Protection Act, 2019, and the Office of the Data Protection Commissioner (ODPC) regulations and guidelines for data protection. Additionally, there is ongoing effort to establish and implement the National Spatial Data Infrastructure (NSDI), with the aim of standardising geospatial data from multiple sources. • Due to new updates in Kenya's policies, this can cause policy uncertainty, and it may be challenging for industries to keep up with policy and regulatory requirements.	
Pathways to scale	• Kenyan universities and research institutions are increasingly involved in space science and technology research. Collaboration with international space agencies and academic institutions can bolster R&D. • The development of space technology (e.g., satellite manufacturing) is in nascent stages, with a few initiatives like the Taifa-1 satellite. Enhanced technological capabilities are essential for scaling. • Increased government funding and budget allocation for space activities are necessary. Also, attracting venture capital and private investment in space start-ups and projects is crucial for scaling up the sector.	

IDIA GOAL	Key Findings	Maturity Level
Collective approach	• Kenya's space ecosystem is characterised by strong collaboration among various stakeholders, including government agencies, academic institutions, and private sector entities. • Despite strong collaborations among stakeholders, duplication of efforts is still inherent within the ecosystem. This can be addressed through the establishment of Communities of Practice, which can lead to greater synergy and efficiency within the sector (RCMRD, 2023). • The ecosystem encourages public-private partnerships to stimulate investment and technological advancement. (e.g., collaboration between the KSA and the private sector company, Avanti Communications, aims to enhance satellite communication services in Kenya, supporting various sectors including education, agriculture, and disaster management). • The Kenyan government provides robust policy and regulatory support to foster a conducive environment for space activities.	

LEGEND:

Table 5: Summary findings and maturity level rating for the four remaining IDIA goals.

Further Considerations

Stakeholder engagements highlight the following considerations for each IDIA goal:

- **Building Human Capital:** Strengthening collaboration and alignment between academia and industry is essential to bridge the skills gap in the industry.
- **Innovation Culture:** An "open-door" policy is needed for collaborative policy development, while capital incentives are essential to foster innovation.
- **Networking Assets:** There is a need to move beyond mere attendance at conferences towards tangible contributions to the field of space technologies used by industry.
- **Access to finance:** Encouraging investors to be less risk-averse towards investing in space technologies, by demonstrating their role in addressing developmental problems, will be key towards ensuring greater access to finance.
- **Equitable and inclusive participation:** Increased exposure and visibility of the space sector for marginalised groups is needed.

4.1.2. Keys to Overcoming Gaps to Achieve Desired Kenyan Space Ecosystem

To facilitate continued growth of the space sector in Kenya, raising awareness in all aspects of the space innovation ecosystem is critical. Figure 9 below shows how Kenya can overcome gaps within the space industry to reach an ideal state.

BUILDING HUMAN CAPITAL

Overcoming Gaps to Industry Development		Desired Kenyan Space Ecosystem
• Leverage technological advancements to create innovative training and upskilling programmes for online learning and skills development. • Encourage local universities to offer space sector-relevant skills and qualifications such as space engineering, data analysis, project and risk management, etc. • Build stronger partnerships between industry and academia. • Provision of scholarships for locals seeking space-related qualifications, to study at relevant institutions.	>	• Increased local skilled labour that can take up opportunities in the space sector. • Increased access to cross-skilling and upskilling opportunities within the space sector. • Clear pathways for adjacent skills and qualifications to join the space sector. • Increased national space capability in Satellite Technology, Remote Sensing and Earth Observation (EO), Space Science and Research, Satellite Applications, Space Education and Training and International Collaborations.

ACCESS TO FINANCE

Overcoming Gaps to Industry Development		Desired Kenyan Space Ecosystem
• Increase availability of finance and access to various financing mechanisms in the industry through public-private partnerships, as well as through leveraging technologies such as blockchain. • Leverage political goodwill and appeal for an increase in the space budget, to increase the availability of space programme funding. • Utilise geographical location advantageously to attract investment into upstream activities.	>	• Increased public and private sector funding of space programmes and activities, as well as overall space industry participation. • Improved financial resource mobilisation through KSA. • Easily accessible funding for space start-ups and innovators.

INNOVATION CULTURE

Overcoming Gaps to Industry Development		Desired Kenyan Space Ecosystem
• Leverage pre-existing entrepreneurial culture to encourage more innovators to enter the space sector and drive the utilisation of space technology. • Raise awareness of the space sector and its importance in driving innovation, growth and development in key national priority areas such as agriculture, services industry, national defence, etc., as well as for overall benefits for societal well-being.	>	• Greater awareness of the role and potential role of space science, technology and services in socio-economic development. • Increased and more diverse space technology application and space science utilisation – across different industries, especially in the six priority pillars of the Bottom-up Economic Transformation Agenda (BETA).

NETWORKING ASSETS

Overcoming Gaps to Industry Development		Desired Kenyan Space Ecosystem
• Leverage existing partnerships with other space agencies to raise funds to host various networking events across the space sector. • Partner with technology and innovation hubs – to support innovators, entrepreneurs and start-ups. • Advocate for government support, policy reforms, and investment incentives to create an enabling environment for industry development.	>	• Increased number and quality of space sector networking opportunities such as conferences, exhibitions, and other convening events. • Increased partnerships between space sector stakeholders, and stakeholders across various industries – including priority areas such as agriculture, industry and national defence. • Improved coordination and partnerships across the space sector.

EQUITABLE & INCLUSIVE PARTICIPATION

Overcoming Gaps to Industry Development		Desired Kenyan Space Ecosystem
• Ringfencing financial and other resources for woman-owned or other marginalised group-owned start-ups, to support and encourage more inclusive and diverse participation in the space sector. • Promotion of, and adherence to laws and policies such as the One Third Gender Rule*, which states that at least one-third of employees at all institutions and organisations be female.	>	• Increased diversity of participation in the space sector. • Increased number of women-owned and other marginalised group-owned start-ups applying space data and technology or active in the space sector.

Figure 9: Summary of gaps that Kenya can overcome across the five IDIA goals

5

KENYAN SPACE SECTOR BENCHMARKING

A benchmarking exercise was conducted to provide a comparative analysis of the Kenyan space ecosystem alongside other space ecosystems within East Africa, across Africa and at a global level. Within the East African region, the analysis focused on countries with demonstrable space activity, namely, Uganda, Rwanda, Sudan and Ethiopia. At the continental level, a comparative analysis was conducted for South Africa, Nigeria and Egypt, as leading space ecosystems in their respective regions. Finally, a global comparative analysis was conducted for Slovakia, Turkey, and Argentina.

The objective of this analysis was to provide insights on the positioning of the Kenyan space ecosystem at a regional and a global level, as well as the overall performance trajectory of each of the selected ecosystems, and to identify potential growth opportunities for Kenya's space ecosystem.

5.1 BENCHMARKING METHODOLOGY

The benchmarking exercise was completed through three activities, namely, a) the Ecosystem Trajectory and Criteria Development; b) Research and Case Study Development; and c) a Comparative Analysis.

The benchmarking exercise began with the development of a set of criteria to measure various factors common within a space ecosystem. These factors determined the level of performance on a five-level space ecosystem development trajectory. Case studies of space ecosystems across East Africa, Africa and globally were researched, developed and analysed to identify their trajectory levels.

The final step involved comparing these case studies to derive actionable insights for effectively developing Kenya's space ecosystem. Refer to **Appendix 6: Benchmarking** for a detailed visual outline of the benchmarking exercise.

5.1.1. Ecosystem Trajectory and Criteria Development

Five levels of a space ecosystem development trajectory were identified and used to classify ecosystems at different development stages. These were nascent ecosystems, developing ecosystems, emerging ecosystems, fast emerging ecosystems and developed ecosystems.

Figure 10 below illustrates and outlines the typical growth path of a space innovation ecosystem, progressing from nascent to developed levels.

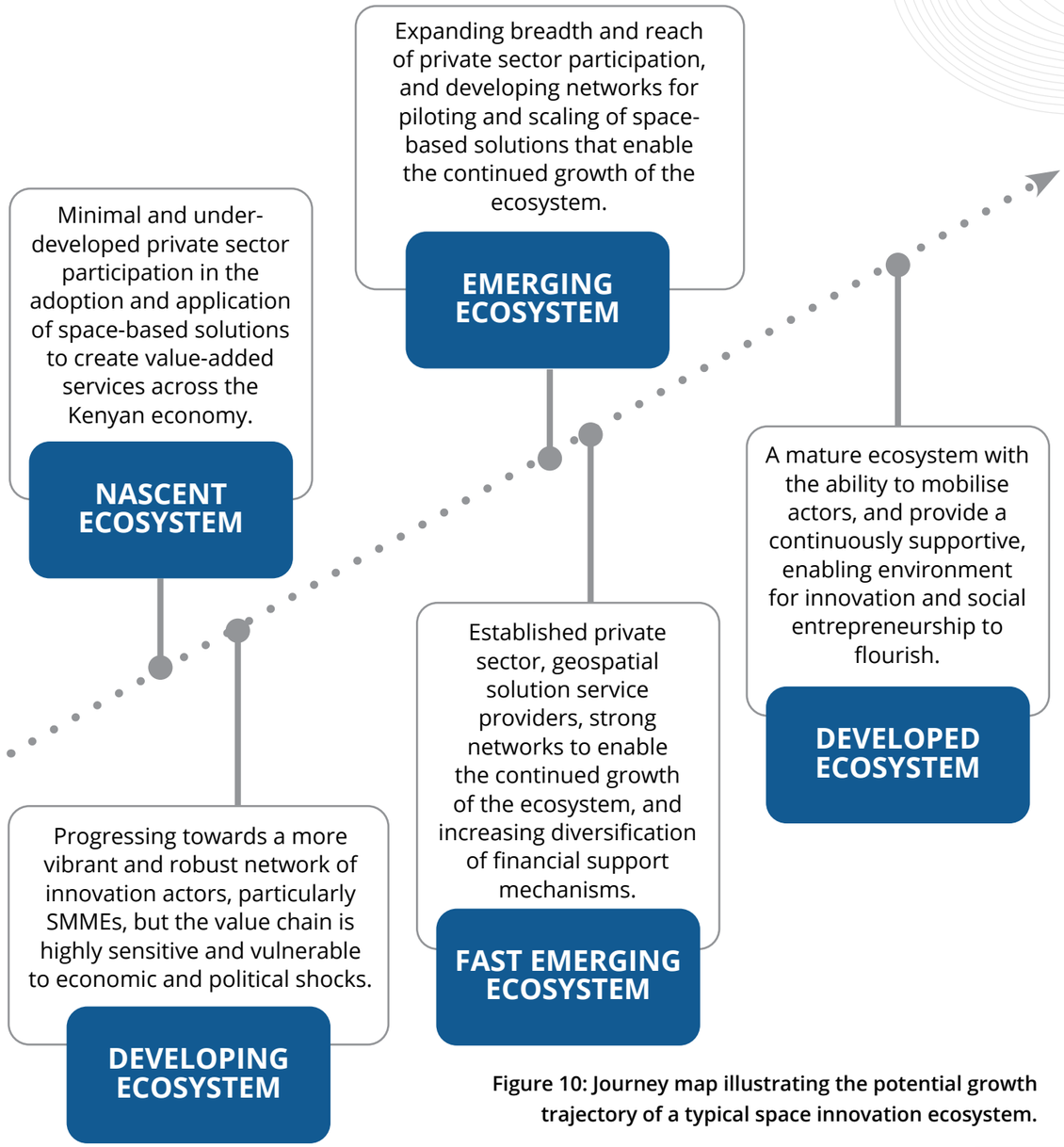


Figure 10: Journey map illustrating the potential growth trajectory of a typical space innovation ecosystem.

A list of criteria was then developed to distinguish between the five levels of the ecosystem development trajectory. For each of the criteria, the relevant IDIA goals were identified. This has been captured in Table 6 below:

	IDIA GOAL	Nascent Ecosystem	Developing Ecosystem	Emerging Ecosystem
Presence of a prominent space actor or consortium (regulatory or governance)		Space agency or programme is non-existent.	Space agency has been established - but limited demonstrable activity.	Space agency/ programme established and has some demonstrable activity
Longevity of space programmes in the country		Active space programmes in the country for 1+ of years.	Active space programmes in the country for 5+ years.	Active space programmes in the country for 10+ years.
Number of space programmes in the country		1+ formalised space programme/s.	5+ formalised space programmes established 2+ years ago.	10+ formalised space programmes established 4+ years ago.
Number of satellites owned and in operation		No satellites launched.	Less than 5 satellites launched.	More than 5, but less than 10 satellites launched.
Investment into the sector per annum		Investment of 2 - 5 M USD into the space sector per annum.	Investment of 5 - 10 M USD into the space sector per annum.	Investment of 10-25 M USD into the space sector per annum.
Technological and scientific advancements as a result of the country's space programmes		No real evidence of technological and scientific advancements as a result of the country's space programmes/ initiatives.	Some technological and scientific advancements as a result of the country's space programmes/ initiatives.	Several technological and scientific advancements as a result of the country's space programmes/ initiatives.
Enabling policies and policy environment involving different stakeholders		Enabling policy that seeks to support the ecosystem and sector, centralised approach.	Enabling policy that supports the ecosystem and sector along at least two of the three streams, a centralised approach.	Enabling policy that supports the ecosystem and sector along at least two of the three streams, a semi de-centralised approach.
Number of private sector companies/ participants in the ecosystem		10+ private sector companies/participants in the ecosystem.	15+ private sector companies/participants in the ecosystem.	25+ private sector companies/participants in the ecosystem.

	IDIA GOAL	Fast Emerging Ecosystem	Developed Ecosystem
Presence of a prominent space actor or consortium (regulatory or governance)		Space agency/programme established and has significant activity and public funding.	Space agency is fully established, receives public funds and is considered a priority.
Longevity of space programmes in the country		Active space programmes in the country for 15+ years.	Active Space programmes in the country for 20+ years.
Number of space programmes in the country		15+ formalised space programmes established 10+ years ago.	20+ formalised space programmes established 15+ years ago.
Number of satellites owned and in operation		More than 10 but less than 15 satellites launched.	15 satellites or more launched.
Investment into the sector per annum		Investment of 25-50 M USD into the space sector per annum.	Investment of 100 M USD+ into the space sector per annum.
Technological and scientific advancements as a result of the country's space programmes		A high number of technological and scientific advancements as a result of the country's space programmes/ initiatives.	Significant number of technological and scientific advancements as a result of the country's space programmes/initiatives.
Enabling policies and policy environment involving different stakeholders		Enabling policy that supports the ecosystem and sector along the three streams, a semi de-centralised approach.	Robust policy that supports the ecosystem and sector along all streams, a decentralised approach.
Number of private sector companies/ participants in the ecosystem		35+ private sector companies/ participants in the ecosystem.	50+ private sector companies/ participants in the ecosystem.

Building Human Capital · Access to Finance · Innovation Culture · Supportive Markets & Infrastructure · Networking Assets · Policies & Regulations · Equitable & Inclusive Participation · Pathways to Scale · Collective Approach

Table 6: Benchmarking Criteria

5.2. COMPARATIVE ANALYSIS: EAST AFRICAN REGION

	Kenya	Uganda	Rwanda
Presence of a prominent space actor or consortium (regulatory or governance)	First the establishment of the National Space Secretariat which led to the establishment of the Kenya Space Agency (KSA) in 2017.	No local space agency. Ministry of Science, Technology and Innovation (MoSTI) est. 2016.	Rwanda Space Agency (RSA) est. in 2020 and has some demonstrable activity.
Longevity of space programmes in the country	Commenced in 1960s with a partnership between the Italian and Kenyan Governments; and 7 years through KSA.	5 years – Uganda space programme resumed in 2019.	4 years through RSA.
Number of space programmes in the country	5+ space programmes.	1+ formalised space programme	1+ formalised space programme.
Number of satellites owned and in operation	2 satellites owned, 1 in operation.	1 owned but not in operation	2 satellites owned and in operation
Investment into the sector per annum	Approximately 3 million USD.	Investment of less than 1 million USD per annum.	Undisclosed.
Technological and scientific advancements as a result of the country's space programmes	Development of CubeSats, amateur rockets and earth observation tools.	Manufacturing a ground station, as well as existing antenna infrastructure.	Development of ground station and teleport, satellite development and establishment of National Geospatial Hub (GeoHub).
Enabling policies and policy environment involving different stakeholders	National Space Policy, Kenya Space Strategy and strategic Plan launched in 2024.	No local space agency to develop and advise on space policy.	No formal space policy in place, however, RSA is mandated to advise on national policies.
Number of private sector companies/ participants in the ecosystem	10+ private sector companies/ participants in the ecosystem.	10+ private sector companies/participants in the ecosystem.	10+ private sector companies/participants in the ecosystem.
Overall country rating	 **Emerging Ecosystem**	 **Nascent Ecosystem**	 **Developing Ecosystem**
	Ethiopia	**Sudan**	
Presence of a prominent space actor or consortium (regulatory or governance)	Ethiopian Space Science and Technology Institute (ESSTI) est. 2016.	Remote Sensing Authority (RSA) est. 1996 and the Institute of Space Research and Aerospace (ISRA) est. 2013.	
Longevity of space programmes in the country	20 years - establishment of The Ethiopian Space Science Society (ESSS) in 2004.	Over 30 years- gained traction in the 1990s.	
Number of space programmes in the country	5+ formalised space programmes.	5+ formalised space programmes.	
Number of satellites owned and in operation	2 satellites owned and in operation.	1 satellite owned and in operation.	
Investment into the sector per annum	Estimated at 10.6 million USD in 2021.	Undisclosed space budget- estimated to be around 6-10 million USD.	
Technological and scientific advancements as a result of the country's space programmes	Development of Entonto Astronomical Observatory and Research Centre, as well as utilisation of EO satellites.	Development of CubeSat prototypes, satellite components and supporting infrastructure (ground stations).	
Enabling policies and policy environment involving different stakeholders	National Space Policy and Strategy was passed in 2018.	No formal space policy document in place, however, RSA offers policy recommendations to the government.	
Number of private sector companies/ participants in the ecosystem	No well-known space tech start-ups or established private enterprises in existence.	No well-known private sector players apart from Sudatel Telecom Group (which owns Sudasat).	
Overall country rating	 **Developing Ecosystem**	 **Developing Ecosystem**	

Table 7: Comparative analysis of space ecosystems of East African countries

Country selection for benchmarking is based on East African countries' shared goals, similar geographical conditions, economic contexts, regulatory environments, and existing regional collaboration within the East African Community. This provides relevant insights for Kenya's space sector and identifies opportunities for joint projects, shared infrastructure, and coordinated policies. This has been captured in Table 7 above.

5.2.1 Kenya

Kenya's space ecosystem analysis shows a clear path for continued growth, demonstrating promising strides in satellite technology and applications.

Rating

Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**2,099 USD**
R&D Expenditure (2022):	**0,8% of GDP**
Number of Satellites in Operation:	**1**
Space Budget:	**5 million USD**

Key Stakeholders in Space Innovation Ecosystem

Overview of key space programmes	• Kenya Space Agency (KSA) was established in 2017 to coordinate and promote space activities in Kenya. • San Marco Project was established in 1964 as a collaboration between the University of Rome and the Italian Space Commission. The San Marco Launch Platform near Malindi was used for launching satellites into low Earth orbit. At present, it is used for telemetry and tracking (ASI, 2019). • 1KUNS is Kenya's first satellite, a 1U CubeSat developed in collaboration with the University of Nairobi and the Japanese Aerospace Exploration Agency (JAXA).
Technological and scientific impact of space programmes	• In 2021, Kenya launched its first Earth Observation satellite, TAIFA-1 and has several ground stations to support satellite activities. • KSA has developed different space programmes for satellite development and space weather such as Research chairs (Funds Beeline, 2020). In addition, establishment of innovation hubs in ICPAC and universities such as UoN, JKUAT, Strathmore University, KU and DeKUT. • KSA Space Club conducts outreach programmes to educate the public, especially students, about space science, astronomy, and related fields (Kenya Space Agency, 2024). • Through partnerships with KSA, Kenyan counties access customised satellite solutions tailored to their specific needs. For example, the use of satellite imagery with high spatial resolution for detailed land use planning, agricultural monitoring, or infrastructure development within their respective regions.
Policy and regulatory environment	• Kenya Space Policy (2016) The Kenya Space Policy (2016) provides strategic guidelines for the growth of the space sector, emphasising national security, socio-economic development, and environmental management. (Kenya Space Agency, 2024). • The Kenya Space Agency Order (2017) established the Kenya Space Agency (KSA) as the regulatory body responsible for coordinating and overseeing Kenya's space activities. • The Kenya Space Strategy (2016) outlines specific objectives and initiatives to enhance the country's space capabilities. It focuses on capacity building, infrastructure development, and international collaboration to advance Kenya's position in the global space arena.
Private sector and commercial space activity	• The private sector and commercial space activity in Kenya is still emerging, with several organizations and companies beginning to establish themselves in the space industry primarily focused on providing satellite-based communication services, broadband internet access, and related solutions to address connectivity challenges in remote and underserved areas.. For example: Safaricom, Angani, and MySat Africa etc.
Lessons Learned	• Kenya capitalised on its existing infrastructure, such as the Malindi Space Center, and formed strategic partnerships with established space agencies. • Kenya has focused on using space technology to address local socio-economic challenges. • Kenya adopted an incremental approach to developing its space capabilities, starting with small-scale projects such as the launch of nano-satellites like 1KUNS-PF. • Kenya has actively participated in regional and international space forums, which has facilitated knowledge exchange and cooperation.

5.2.2 Uganda

Uganda's space ecosystem analysis shows dynamic entrepreneurship and growing private involvement in building space capabilities. However, the sector is still in its nascent stages, with growth hindered by limited investment and regulatory gaps.

Rating

Nascent Ecosystem

Economic Context

GDP per Capita (2022):	**964 USD**
R&D Expenditure (2022):	**0,14% of GDP**
Number of Satellites in Operation:	**0**
Space Budget (2021):	**<1 million USD**

Key Stakeholders in Space Innovation Ecosystem

Overview of key space programmes	• To date, Uganda has no local space agency. The Ministry of Science, Technology and Innovation (MoSTI) established in 2016 is the leading government institution operating its space initiatives (European Union, 2021). • Despite its limited success in the 1970s (i.e., joining global space laws), Uganda's space programme resurfaced in 2019 with more definite ambitions to progress its space industry following a meeting with the Russian-Ugandan Intergovernmental Commission on Economic Scientific and Technological Cooperation (European Union, 2021). • Some of the concrete plans include satellite development and launch, increased adoption of space science education, and building supportive space-related facilities (e.g., ground stations).
Technological and scientific impact of space programmes	• Owned and launched PearlAfricaSat-1 but it was removed from space almost a year later. • Uganda is actively promoting space education through various initiatives, including launching a space programme at Makerere University, sending three scientists to participate in Japan's BIRDS program to develop Uganda's first satellite, proposing the construction of an educational satellite (UGASAT 1), and exploring a partnership with CERN to establish a space camp. • Manufacturing of a ground station (Space in Africa, 2020; European Union, 2021). • Existing antenna infrastructure used by Intelsat (US) for telecommunication services (European Union, 2021). • Uganda Vision 2040 initiatives will increase the use of space-based applications in various sectors (i.e., transport infrastructure, urban planning, and land mapping/ demarcation) (European Union, 2021).
Policy and regulatory environment	• Uganda became a signatory to two key international space law treaties—the Partial Nuclear Test Ban Treaty in 1964 and the Outer Space Treaty in 1968. However, without the establishment of a dedicated space agency to guide policy and activities, the country has yet to formalise a national space policy.
Private sector and commercial space activity	• Uganda's space start-up ecosystem is in a nascent stage. The space private sector encompasses satellite-focused companies (e.g. Space Technology Agency (STA), Spacecom, StarSat, etc.). • Uganda has a thriving entrepreneurship and innovative culture due to its competitive tech private sector, however, growth is plagued by financial constraints, lack of strategic direction and regulatory framework for entrepreneurship (Giuliani & Malinz, n.d.).
Lessons Learned	• Private sector participation is imperative in building specialised space sector knowledge base and interest: STA has youth lead Nano-satellite design project, NASA scientist competitions, Space Tech Club for Juniors, etc.). • Housing a dynamic ecosystem hub is key to foster innovation, collaboration and growth between start-ups, entrepreneurs, innovators and investors: The Innovation Village in Uganda nurtures entrepreneurship. However, more needs to be done in terms of developing pro-business regulations.

5.2.3. Rwanda

Rwanda's space ecosystem analysis reveals significant traction in technological development and strategic partnerships, supported by the recent establishment of its space agency. Its reputation as a leading African financial hub attracts substantial foreign investment, advancing its space sector.

Rating

Developing Ecosystem

Economic Context

GDP per Capita (2022):	**966 USD**
R&D Expenditure (2022):	**0,76% of GDP**
Number of Satellites in Operation:	**2**
Space Budget:	**Undisclosed**

Key Stakeholders in Space Innovation Ecosystem

GSOA GLOBAL SATELLITE OPERATORS ASSOCIATION

OneWeb

JICA Japan International Cooperation Agency

smart africa CONNECT. INNOVATE. TRANSFORM

unitar United Nations Institute for Training and Research

UNOSAT

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT

UNITED NATIONS Office for Outer Space Affairs

Overview of key space programmes	• The Rwanda Space Agency (RSA), was founded in 2020 to advance the country's space industry toward social and economic development (Rwanda Space Agency, 2024). • Prior to RSA's establishment, two EO satellites were launched in 2019 (i.e., RwaSat-1 and Icyerekezo), in partnership with Japan Aerospace Exploration Agency (JAXA) and One Web (communications) respectively (European Union, 2021). • RSA is set to build satellite ground stations and teleport for EO and Communications with GlobalStar. These recent developments further demonstrate their dedication to the responsible utilisation of space as members of the Committee on the Peaceful Uses of Outer Space (COPUOS) (BrandVoice Partner, 2024).
Technological and scientific impact of space programmes	• RwaSat-1 monitors weather patterns to assist with agriculture decision-making, disaster management, and climate change strategies. Icyerekezo connects remote schools to the Internet (Rwanda Space Agency, 2024). • Development of indicator system that streamline satellite data into actionable insights used for decision-making and tracking national goals. • Establishing a National Geospatial Hub (GeoHub) to support critical socio-economic sectors (Rwanda Space Agency, 2024). • RSA has several outreach activities (e.g. Space Week Conference, outreach workshops) and university collaborations (e.g., Carneige Mellon University and University of Rwanda CGIS) to build human capital.
Policy and regulatory environment	• RSA is mandated to advise on national and international space policies and regulations that encourages space sector and start-up growth. A national space policy and strategy is not openly disclosed. • Rwanda has an agreement with the Global Satellite Operator's Association (GSOA) which will go a long way towards establishing the framework to enhance the availability of satellite communications in Rwanda. The agreement with GSOA allows RSA to collaborate with other African space agencies (Global Satellite Operators Association, 2022). • As a member of the Artemis accord, RSA has a direct pathway to advanced technology sharing, capacity building, development of space industry applications (Space in Africa, 2022).
Private sector and commercial space activity	• Rwanda has a thriving private sector but limited private-public collaboration. • RSA's partnership with Westerwelle start-up Haus Kigali launched the Innovation for SpaceTech Acceleration in Rwanda (iSTAR) programme designed to empower start-ups to harness satellite imagery and geospatial data (Kagina, 2024). • Rwanda is establishing itself as the leading financial hub for technology and digital transformation through the Kigali International Financial Center. This will aid in the flow of investments into its space industry (BrandVoice Partner, 2024).
Lessons Learned	• Building strategic partnerships is key to attract significant international funding and support: Rwanda has significant financial backing from organisations like the United Nations Office for Outer Space Affairs (UNOOSA) and the International Astronautical Federation (IAF). • Attracting venture capitalists and private equity are key to raising funds: In 2023, Rwanda raised 38 million USD funding for tech start-ups, a six-fold increase from 2022 (BrandVoice Partner, 2024).

5.2.4. Ethiopia

Ethiopia's space ecosystem analysis, particularly its satellite data reception stations, showcases how other African nations can leverage space infrastructure for commercial gain and engage in the global satellite data market.

Rating

Developing Ecosystem

Economic Context

GDP per Capita (2022):	**1,027 USD**
R&D Expenditure (2022):	**0,27% of GDP**
Number of Satellites in Operation:	**2**
Space Budget (2021):	**10,6 million USD**

Key Stakeholders in Space Innovation Ecosystem

Overview of key space programmes	• The Ethiopian Space Science Society (ESSS) was founded in 2004 to promote space activities in the country. In 2016, Ethiopian Space Science and Technology Institute (ESSTI) and Council (ESSTC) arose from ESSS as the country's central institutional bodies for space-related matters (European Union, 2021). • With the support of the China Academy of Space Technology (CAST), Ethiopia launched its first satellite, ETRSS-1, in 2019. The Earth observation satellite is still operational to date and transmits images to a ground station located in Addis Ababa (SiA, 2019). • Ethiopia launched its second EO satellite ET-SMART RSS in 2020 (European Union, 2021).
Technological and scientific impact of space programmes	• In 2013, the ESSTI established the Entoto Observatory and Research Centre (EORC) as Ethiopia's main astronomical observatory (ESSTI, 2015). • The two Earth Observation satellites in operation are used to monitor environmental and weather patterns mainly for agriculture planning, infrastructure, water resource and natural disaster monitoring (European Union, 2021). • In 2021, ESSTI opened a new multi-satellite ground station to advance its EO capabilities while also commercialising the data by selling to neighbouring countries (SiA, 2019).
Policy and regulatory environment	• Ethiopia's national space policy and strategy was passed in 2018 and seeks to drive activity within the space sector . • The policy has a strong drive for collaboration particularly between various entities including the government, higher education and research institutes, civil society organisations and the private sector (SiA, 2019).
Private sector and commercial space activity	• The Ethiopian Space Science and Geospatial Institute (SSGI) generates revenue by providing ground station services through its satellite data receiving station, to over 11 satellites across numerous countries and organisations (SiA , 2024). • The Ethiopian space private sector is in a nascent stage and private organisations seeking to work on satellite-building initiatives need to obtain licenses and permission from the government.
Lessons Learned	• Through the SSGI's administration of the data reception station, Ethiopia has positioned itself as a critical player in the global satellite data market and shows other African countries how space infrastructure can be utilised for economic gain.

5.2.4. Sudan

Sudan's space ecosystem analysis highlights its strong collaboration with key players to cultivate talent and attract them to the space sector. The involvement of universities and research institutes with specialised programmes is crucial for developing industry-ready skills and fostering innovation within Sudan's space ecosystem.

Rating

Developing Ecosystem

Economic Context

GDP per Capita (2022):	**1,027 USD**
R&D Expenditure (2022):	**0,22% of GDP**
Number of Satellites in Operation:	**1**
Space Budget (2021):	**Undisclosed**

Key Stakeholders in Space Innovation Ecosystem

Overview of key space programmes	• National space activities in Sudan began in the 1970s with the establishment of the National Remote Sensing Centre (NRSC) (European Union, 2021). • NRSC later restructured and renamed to the Remote Sensing Authority (RSA) in 1996. RSA conducts research in remote sensing, and geoinformatics. • The Institute of Space Research and Aerospace (ISRA) was established in 2013. ISRA's research includes satellite design, aerospace engineering, space physics and space navigation. • Universities in Sudan such as Future University and the University of Khartoum offer programmes in space science and astronomy and have specialised space research centres. • Sudan has an operational EO satellite called SRSS-1, built & launched in partnership with China (spacewatch, 2019).
Technological and scientific impact of space programmes	• University CubeSat programmes have built local expertise by training students to develop CubeSat prototypes and small satellite components (SiA, 2019). • Sudan has invested in infrastructure development for its space programme, including upgrades to its ground station, the Abu Haraz satellite station, to facilitate ground station services for global satellite operators. • Satellite imagery from the SRSS-1 has assisted with environment and resource management and improved agricultural productivity in the country (spacewatch, 2019).
Policy and regulatory environment	• The Sudanese space programme has received significant support from the government, evidenced by the various bodies (i.e., RSA and ISRA) that have been established to coordinate space activities in the country. • RSA collaborates with academic institutions and offers policy recommendations to the government. • The Sudanese government encourages partnerships between public sector, private sector and civil society.
Private sector and commercial space activity	• The space start-up ecosystem in Sudan is still in a nascent stage. • Sudatel Telecom Group is Sudan's largest publicly-traded telecommunications company. It has an existing partnership with Arabsat to leverage the four Ka-band transponders onboard Arabsat 6A, to provide broadband communications and services across the Sudanese territory (Cherian, 2019).
Lessons Learned	• The Sudanese government frequently collaborates with the academic community, while universities and research institutes play a leading role in the development of the Sudanese space sector, by offering specialised space science programmes and applied cubesat programmes, they provide industry ready-critical skills to students and produce many technological outputs.

5.3. COMPARATIVE ANALYSIS: AFRICA REGION

Benchmarking Kenya's space ecosystem with other advanced African countries is crucial to adopt effective practices, strategies, and innovations, identify collaboration opportunities, promote regional integration through cooperation and knowledge sharing, and assess Kenya's competitiveness in the global space market. This has been captured in Table 8 below.

	Kenya	Nigeria	Egypt	South Africa
Presence of a prominent space actor or consortium (regulatory or governance)	Space agency has been established since 2017, the Kenya Space Agency (KSA).	National Space Research and Development Agency (NASRDA) (1999) and others (i.e., Nigerian Communications Satellite Ltd. (NigComSat), Defence Space Administration (DSA)).	National Authority for Remote Sensing & Space Sciences (NARSS) est. 1991 and Egyptian space agency (EgSA) est. 2019.	SANSA was established in 2010 and has significant public funding and space activity.
Longevity of space programmes in the country	Commenced in 1960s with a partnership between the Italian and Kenyan Governments; and 7 years through KSA.	20+ years – space activities since the 1960s with NASA.	30+ years - Space programmes began in the 1960s but only gained traction in the 1990s.	30+ years – started satellite and launch activities in 1980s.
Number of space programmes in the country	5+ formalised space programmes.	10+ formalised space programmes established 4+ years ago.	10+ formalised space programmes. From across universities, government and industry.	15+ formalised space programmes established 10+ years ago.
Number of satellites owned and in operation	2 satellites owned, 1 in operation.	6 satellites owned and 3 in operation.	13 satellites owned and in operation.	13 satellites owned and in operation.
Investment into the sector per annum	Approximately 3 million USD.	Estimated 78 million USD in 2021.	Estimated at 40 million USD in 2021.	Estimated 172 million USD in 2021.
Technological and scientific advancements as a result of the country's space programmes	Development of CubeSats, amateur rockets and earth observation tools.	Satellite development, two ground stations, six research centres and two companies.	Satellites development, ground stations and a Space City cluster in Cairo.	Satellite development and other supportive infrastructure exist (i.e., observatories, R&D labs, space weather centres, etc.)
Enabling policies and policy environment involving different stakeholders	National Space Policy, Kenya Space Strategy and strategic Plan launched in 2024.	National Space Policy (2000), National Space Council (NSC) for licensing, Defence Space Administration (DSA) for defence and security policies.	EgSA is responsible for implementing Egypt's space policy. Egypt commenced a ten-year National Space Programme in 2019.	National Space Policy (2008), National Space Strategy (2018), National Space Affairs Act (1995).
Number of private sector companies/participants in the ecosystem	10+ private sector companies/ participants in the ecosystem.	15+ private sector companies/ participants in the ecosystem.	35+ private sector companies/ participants in the ecosystem.	50+ private sector companies/ participants in the ecosystem.
Overall country rating	 **Emerging Ecosystem**	 **Emerging Ecosystem**	 **Emerging Ecosystem**	 **Fast-Emerging Ecosystem**

Table 8: Comparative analysis of space ecosystems of African countries

5.3.1. Nigeria

Based on the analysis of Nigeria's space ecosystem, it has made significant strides in satellite technology, launches, and applications, demonstrating a strong commitment to using space technology to drive economic development, bolster national security, and enhance societal welfare across diverse sectors.

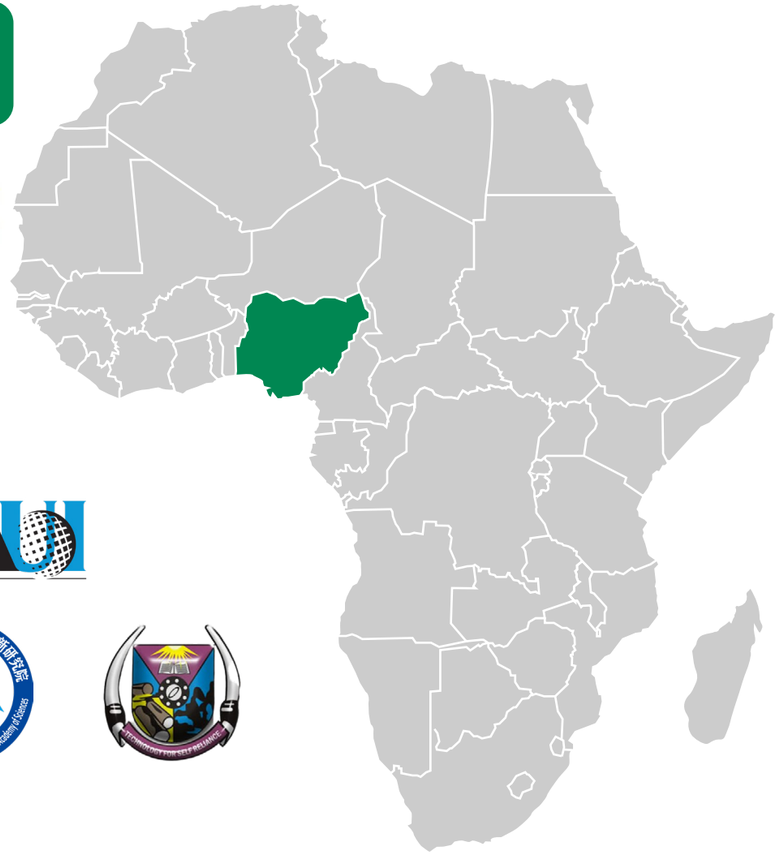
Rating

Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**2,163 USD**
R&D Expenditure (2022):	**0,28% of GDP**
Number of Satellites in Operation:	**3**
Space Budget (2021):	**78 million USD**

Key Stakeholders in Space Innovation Ecosystem



Overview of key space programmes	• Nigeria has one of the most developed space sectors in Africa, running two ground stations and three active satellites (European Union, 2021). • It's the first African country to establish a space programme and space policy and declare its aspirations in space. • The National Center for Remote Sensing (1998) was established and soon after the National Space Research and Development Agency (NASRDA) was established in 1999 as an agency in charge of overseeing the nation's space activities (European Union, 2021).
Technological and scientific impact of space programmes	• Satellite development (e.g., 2003: NigeriaSat-1l 2007: NigComSat-1; 2011: NigeriaSat-2; NigeriaSat-X and NigComSat-1R; 2017: NigeriaEduSat-1; Tele). • Two major ground stations (i.e., The National Center for Remote Sensing in Jos and the Center for Satellite Technology and Development in Abuja) (European Union, 2021). • Infrastructural Development for building space knowledge bases include Space Museum and Planetarium, Conference Centre to promote interest, awareness and collaboration in Nigeria space sector. • NASRDA launched Telemedicine facility in 2020 to support and bring COVID-19 services to remote areas using satellite applications. • NASDRA Rocketry programme - rocket development in collaboration with Air Force. • Six research centres (e.g. Centre for Remote Sensing, Jos; Centre for Satellite Technology Development, Abuja; Centre for Geodesy and Geodynamics, Toro; Centre for Space Transport and Propulsion, Epe; Centre for Basic Space Science and Astronomy, Nsukka; and Centre for Space Science and Technology Education, Ile-Ife.) and two companies (e.g. Nigeria Communication Satellite (NigComSat, 2006) and GeoApps Plus Limited in 2007) were established as part of short-term economic development plan.
Policy and regulatory environment	• NASRDA facilitates all space activities within the country and their utilisation by both citizens and non-citizens (National Space Research and Development Agency, 2024). • The Defence Space Administration (DSA), established in 2016, implements the defence and security aspects of the national space policy and programme. • The National Space Policy (2000) facilitates the main goals (i.e., Nigerian astronaut, a Nigerian made satellite and a launch site by 2025) of Nigeria space programme (Space Security Portal, 2024). • Nigeria's space regulator, the National Space Council (NSC), issues industry licenses but lacks provisions for private partnerships, limiting private companies to a minor role.
Private sector and commercial space activity	• Nigeria's space private sector is developing. The absence of a clear licencing procedure or regulation governing their entry and operation in the industry limits industry access. • Nigeria has an abundance of satellite internet providers that brings connectivity to rural areas (e.g. Eutelsat, SES, Viasat, Avanti, YahClick, and Coollink).
Lessons Learned	• A strong policy framework is crucial to guarantee the successful implementation of national space strategies: Nigeria's space programmes are evident that a thorough space policy and regulatory framework are important. However, a more inclusive space policy is needed to foster public-private partnerships.

5.3.2. Egypt

Egypt's space sector has advanced in satellite technology and applications, bolstered by investments in capabilities and a supportive entrepreneurial ecosystem Successful satellite launches for telecommunications, Earth observation, and scientific research reflect Egypt's dedication to using space technology for national development, infrastructure enhancement, environmental monitoring, and scientific progress.

Rating

Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**4,300 USD**
R&D Expenditure (2022):	**1,02% of GDP**
Number of Satellites in Operation:	**13**
Space Budget (2021):	**40 million USD**

Key Stakeholders in Space Innovation Ecosystem

EgSA
وكالة الفضاء المصرية
Egyptian Space Agency

ZR3I.COM

NARSS

CAIRO UNIVERSITY

Nilesat

Overview of key space programmes	• The National Authority for Remote Sensing & Space Sciences (NARSS) was established in 1991. while the Egyptian space agency (EgSA) was established in 2019 (Faboade, 2023). • EgSA and NARSS have both been involved in several space initiatives including satellite missions, R&D projects and capacity building and training (Shay, 2018). • The African Space Agency was formally established in January 2023 and is domiciled within the newly refurbished Egypt Space City in Cairo. The agency aims to foster collaboration on space initiatives among African countries (Makary, 2022). • Since the launch of its first satellite (Nilesat-1) in 1998, Egypt has launched a total of 13 Satellites as of Q2 of 2024 (Spacehubs Africa 2020).
Technological and scientific impact of space programmes	• The TIBA-1 satellite has significantly improved telecommunication services, internet connectivity, and broadcasting in Egypt and neighbouring regions. • Egypt's EO satellites have contributed to environmental monitoring efforts and advancements in sustainable agriculture. • Egypt has developed supporting ground infrastructure for satellite control and data reception. • Egypt Space City in Cairo is equipped with a satellite assembly integration and testing (AIT) facility, a centre for spacecraft design and development, satellite monitoring stations, a space museum, and a fully-equipped modern library for space research (Adetola, 2023).
Policy and regulatory environment	• The EgSA works closely with NARSS. NARSS manages space applications (mostly downstream and midstream), and the EgSA manages space technology for satellites (mostly upstream). • In 2019, Egypt unveiled it's 10-year National Space programme which complements The national Sustainable Development strategy 2020-2030 and highlights enabling policies to grow the space sector in Egypt (SiA, 2020).
Private sector and commercial space activity	• Egypt has a growing private space sector with many emerging start-ups focused on building downstream applications for sustainable agriculture. • Nilesat is a leading privately–owned satellite operator. It operates multiple geostationary satellites that provide communication services to Egypt and other regions within the Middle East (Mughal 2024).
Lessons Learned	• The Egyptian government has developed a long-term strategic vision which aligns space activities with national development goals. • Egypt's emphasis on fostering local expertise in satellite design, manufacturing, and operations has led to the development of indigenous technologies that specifically address the country's unique challenges. • Organisations like EgSA and NARSS play a significant role in supporting start-ups and private sector development.

5.3.3. South Africa

South Africa excels in satellite technology and applications, supported by specialised university programmes that bolster its international space network and commercial space sector. Successful satellite launches for communication, Earth observation, and scientific research highlight its commitment to national development and global scientific advancement. South Africa's thriving space ecosystem is fuelled by active private companies and strong venture capital funding.

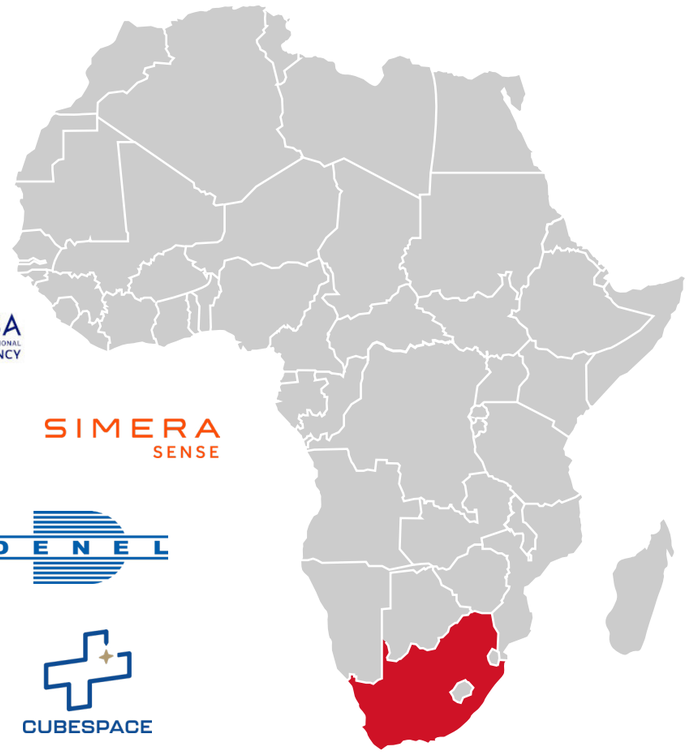
Rating

Fast Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**6,766 USD**
R&D Expenditure (2022):	**0,60% of GDP**
Number of Satellites in Operation:	**13**
Space Budget (2021):	**172 million**

Key Stakeholders in Space Innovation Ecosystem



Overview of key space programmes	• South Africa's involvement in space science began in 1841 with the establishment of the Hermanus Magnetic Observatory (HMO) for studying geomagnetic fields. • Space engineering activities started in the mid-1980s with the Greensat programme and the establishment of the Denel Overberg test facility, which is now used for launching and tracking experimental sounding rockets. • South Africa launched its first satellite (SunSat) in 1999. It was built by graduate students at Stellenbosch University (Atlas, 2015). • The South African National Space Agency (SANSA), established in 2010, coordinates space-related activities with other organisations like the Council for Scientific and Industrial Research (CSIR), the Department of Science and Innovation (DSI) (European Union, 2021). • The Square Kilometre Array (SKA) Telescope, the world's largest radio telescope, is being constructed in the Karoo, South Africa, with international collaboration from eleven countries (The South African Radio Astronomy Observatory, 2024).
Technological and scientific impact of space programmes	• The Hartebeesthoek Radio Astronomy Observatory (HartRAO) was built by NASA in 1961 as a tracking station to support several space missions including the lunar orbiter spacecraft (South Africa National Space Agency, 2024). • 2014, SANSA opened the first non-magnetic temperature chamber in southern Africa, assisting spacecraft manufacturers with improving the navigation functionality of spacecraft. SANSA also built an Optical Space Research Laboratory (OSR) that provides globally available space science data (South Africa National Space Agency, 2024). • SANSA's Space Weather Centre in Hermanus provides critical updates and warnings on space weather events that may impact space assets and on-ground infrastructure (South Africa National Space Agency, 2024). • South Africa has invested significantly in developing high performance computing infrastructure, telecommunications networks and sensor technologies to support the SKA project.
Policy and regulatory environment	• The National Space Policy and Strategy outlines the nation's strategic vision, objectives, and governance structures for space activities along with initiatives to achieve them (SANSA, 2018). • The National Space Affairs Act outlines legislation governing space activities ensuring compliance with international laws and treaties. • There is clear collaboration between public sector, industry, academia and civil society.
Private sector and commercial space activity	• SA has a healthy commercial space ecosystem with several active private companies, some developing launchers (i.e., DeltaV Aerospace), manufacturing satellite subsystems (i.e., NewSpace systems, CubeSpace ADCs, Simera Sense), and others building downstream applications (i.e., Geosense, Pinkmatter Solutions) mainly in the domain of Earth Observations (Iderawumi, 2023). • South Africa's commercial space ecosystem thrives, largely due to robust venture capital (VC) funding for its space tech startups. Notable examples of venture investments as of 2024 include 3M USD in CubeSpace, 15M USD in Simera Sense, and 41.5M USD in Dragonfly Aerospace (Adetola; ITWeb; Tracxn, 2024).
Lessons Learned	• Developing specialised skills tailored to specific industries is essential for fostering a thriving commercial sector: SA's healthy commercial space sector stems from tailored university programs like Stellenbosch University's Electronics and Space Lab, which cater to industry-specific needs. • Leveraging strong international relationships with other space agencies is key for capacity building efforts and enhancing competitiveness: Prominent partners for capacity building in SA includes ESA, NASA, UNOOSA, JAXA, ROSCOSMOS and CNSA.

5.4. COMPARATIVE ANALYSIS: GLOBAL

As part of this benchmarking analysis, the report evaluates countries' space ecosystems on a global scale. Benchmarking Kenya's space sector with global counterparts is crucial for adopting best practices, assessing Kenya's position in the global space market, fostering partnerships with international entities, and gaining exposure to innovative approaches that enhance the development of its space sector. This has been captured in Table 9 below.

	Kenya	Slovakia	Turkey	Argentina
Presence of a prominent space actor or consortium (regulatory or governance)	Space agency has been established since 2017, the Kenya Space Agency (KSA).	The Commission for Space Activities est. 2015 and the Slovak Space office est. 2021.	The Turkish Space Agency (TUA) established in 2018.	National Space Activities Commission (CONAE) established in 1991.
Longevity of space programmes in the country	Commenced in 1960s with a partnership between the Italian and Kenyan Governments; and 7 years through KSA.	10+ years – Significant space activity only began after 2015 and grew after Slovakia's membership with ESA.	20+ years- space program began with the establishment of the Turkish Space Research Institute (TÜBİTAK UZAY).	Active Space programmes in the country for 20+ years.
Number of space programmes in the country	5+ formalised space programmes.	10+ formalised space programmes spanning academia and industry and mostly conducted in partnership with other European nations through ESA contracts.	10+ space programmes, formalised from across universities, government and industry mostly conducted in partnership with other European partners.	15+ formalised space programmes established 10+ years ago from across universities, government and industry mostly conducted in partnership ESA partners.
Number of satellites owned and in operation	2 satellites owned, 1 in operation.	2 satellites launched.	8 satellites owned and 6 in operation.	38 satellites launched.
Investment into the sector per annum	Approximately 3 million USD.	Undisclosed.	Estimated at 600 million USD in 2023.	Estimated at 78 million USD in 2021.
Technological and scientific advancements as a result of the country's space programmes	Development of CubeSats, amateur rockets and earth observation tools.	As of 2022, at least 38 space technology innovations, relating to both the upstream and downstream, have been developed by Slovakian companies and academia through ESA contracted projects.	As of 2023, at least 50 space technology innovations, relating to both the upstream and downstream sectors, have been developed.	Rocket and missile development, 3 launchpads, 2 single disc radio telescopes, 2 antennas and multiple space technology and research centres.
Enabling policies and policy environment involving different stakeholders	National Space Policy, Kenya Space Strategy and strategic Plan launched in 2024.	The Slovak Space Policy Association (SSPA), Ministry of Education and Science and Slovak Investment and Trade Development Agency analyses policy, governance, law, budget and start-up fundraising.	National Space Policy, Space Strategy, IP Policy for space technology is established.	National Space Plan (PEN. 2016-2027), Geostationary Satellite Plan and the Plan Conectar. Various other governmental entities are responsible for conducting space activities.
Number of private sector companies/participants in the ecosystem	10+ private sector companies/ participants in the ecosystem.	30+ private sector companies/ participants in the ecosystem.	30+ private sector companies/ participants in the ecosystem.	35+ private sector companies/ participants in the ecosystem.
Overall country rating	 **Emerging Ecosystem**	 **Emerging Ecosystem**	 **Fast-Emerging Ecosystem**	 **Fast-Emerging Ecosystem**

Table 9: Comparative analysis of Global space ecosystems

5.4.1. Slovakia

Slovakia's space industry centres on satellite technology, successfully launching satellites for communication, Earth observation, and scientific research. Government support through favourable policies, funding, and strategic initiatives, alongside membership in ESA, has bolstered its development.

Rating

Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**21,257 USD**
R&D Expenditure (2022):	**0,92% of GDP**
Number of Satellites in Operation:	**1**
Space Budget:	**Undisclosed**

Key Stakeholders in Space Innovation Ecosystem

Overview of key space programmes	• In 2015, The Commission for Space Activities in the Slovak Republic was established to coordinate activities of the relevant ministries, academia and businesses (SSPO, 2023). • In 2021, the Slovak Space office was established under the national Ministry of Education, Science and Research and Sport (MESRS SR) and the Slovak Investment and Trade Development Agency (SARIO). • In 2022, Slovakia obtained associate membership into the European Space Agency (ESA) facilitating opportunities for cooperation between Slovakia and other European partners. • There are various other community initiatives, like the Slovak Organisation for Space Activities, -that developed and launched the first Slovak satellite (skCube), and the Slovak Aerospace Cluster which aim to grow the Slovak space industry (Liptáková, 2017).
Technological and scientific impact of space programmes	• At least 38 space technology innovations, relating to both the upstream and downstream, have been developed by Slovakian companies through ESA contracted projects. • The Slovak Academy of Science along with various other academic and R&D institutions has actively participated in several international space missions ranging from chemical analysis of asteroid samples to space hardware development (SAS, 2024).
Policy and regulatory environment	• The Slovak Space Policy Association (SSPA) analyses policy, governance, law and European space integration and aims to boost public discussion about issues concerning the use of outer space and its impact on society and businesses. • The MESRS SR is responsible for governmental coordination of space activities in Slovakia, including space policy, budget, and multilateral intergovernmental cooperation. • The SARIO is mainly involved in implementation and focuses on assisting start-up participation in the Slovakian space industry and building international partnerships (SSPO, 2023).
Private sector and commercial space activity	• As of 2024, there are around 46 companies that actively involved in the Slovakian space sector. Around 58% of these companies are focused on the upstream segment in areas such as spacecraft component manufacturing, ground systems and mission plaining and testing to name a few. • Much of the private sector downstream focus is on Earth Observation and Navigation and Positioning, with around 19 companies operating in these two domains (SSPO, 2023).
Lessons Learned	• Slovakia has a healthy commercial space sector and effectively leverages opportunities through their membership with the European Space Agency to develop technologies and grow innovation locally. • The Slovak Space Office helps streamline entry for international players into the Slovak space sector and creates opportunities for new space start-ups to grow and participate in the ecosystem.

5.4.2. Turkey

Turkey has invested significantly in developing its space capabilities, in terms of satellite technology, successfully launching satellites for communication, Earth observation, and scientific research. It continues to foster a growing space entrepreneurial ecosystem through the support of government entities.

Rating

Fast Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**10,674 USD**
R&D Expenditure (2022):	**1,05% of GDP**
Number of Satellites in Operation:	**6**
Space Budget:	**600 million USD**

Key Stakeholders in Space Innovation Ecosystem

aselsan

ROKETSAN

Turkish Space Agency

TÜBİTAK UZAY

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Kablo TURKSAT

Overview of key space programmes	• Since 1968 the Turkish Aerospace Industries (TAI) has played a key role in the space development. • Later, in 2018 the Türkiye Uzay Ajansi (TUA), Turkish Space Agency was established (Turkish Space Agency, 2021). • Turkey launched their first satellite, Turksat in 1994 followed by a series of other satellites. It developed its own earth observation satellite under the GÖKTÜRK programme.
Technological and scientific impact of space programmes	• Turkey has advanced indigenous satellite technology for communication, earth observation, and scientific research, exemplified by projects like GÖKTÜRK-1. The country has made substantial investments in infrastructure, skilled workforce, and technological innovation, including the establishment of Satellite Assembly, Integration, and Test (AIT) Centers (Turkish Space Agency, 2021). • Additionally, Turkey has concentrated on research and development in space technologies, focusing on propulsion systems, sensors, and materials. • Turkey contributes to global Earth science research by providing valuable data for environmental monitoring, disaster management, agricultural planning, and urban development by use of GÖKTÜRK-1, GÖKTÜRK-2, and RASAT satellites (Turkish Space Agency, 2021).
Policy and regulatory environment	• The Turkish Space Agency (TUA) regulates the country's space activities which covers licensing, registration, safety standards, international cooperation framework and compliance. They have a National Space Policy that guides the development of space related programmes and initiatives (Turkish Space Agency, 2021). • Turkish Patent and Trademark Office (TÜRKPATENT), along with the TUA, ensures the protection of intellectual property rights related to space technologies, inventions, and innovations (Turklegal, 2020). The TUA, in collaboration with the Ministry of Environment and Urbanisation, addresses the environmental impacts of space activities.
Private sector and commercial space activity	• As of 2024, there are approximately 30 private companies contributing to the Turkish space sector. These companies are involved in both upstream and downstream segments of the space economy. In the upstream segment, which includes activities like satellite design, manufacturing, and launch services, there are around 12 companies. In the downstream segment, which encompasses the utilisation of satellite data for various applications such as communication, navigation, and Earth observation, there are about 18 companies.
Lessons Learned	• Turkey has focused on developing indigenous satellite capabilities and encourages private sector participation in the space industry. • Turkey has made significant efforts to build a skilled workforce by promoting STEM education, establishing specialised university programmes, and offering training in space-related fields. • Turkey has emphasised the development of dual-use technologies that serve both civilian and defense purposes. • Its space sector growth is backed by strong political will and a long-term vision.

5.4.3. Argentina

Argentina's space sector features a sophisticated ecosystem with research centres, academic institutions, and private enterprises. Supported by robust governmental commitment and partnerships, Argentina's space program advances space technology, bolstering its capabilities for national development and global scientific contributions.

Rating

Fast Emerging Ecosystem

Economic Context

GDP per Capita (2022):	**13,650 USD**
R&D Expenditure (2022):	**0,52% of GDP**
Number of Satellites in Operation:	**3**
Space Budget:	**78 million USD**

Key Stakeholders in Space Innovation Ecosystem

UNIVERSIDAD D CÓRDOBA

CONAE

SATELLOGIC

LIA AEROSPACE

Universidad Nacional de San Martín

INVAP

Argentina.gob.ar

Overview of key space programmes	• Argentina's space voyage began with rocket research and development in 1960s. • The Air Force established the first space-related entity, the National Commission for Space Research (CNIE), in 1961. Thereafter, the Aeronautical and Space Research Institute was established for sounding rocket development (e.g. Orion, Canopus, Castor) (European Space Policy Institute, 2021). • The nature of Argentina's space programme focused on defence and security during the time it faced war and disputes (i.e., Gamma Centauro rocket in 1965; Orion II rocket in 1966, Condor I missile in 1970). • Due to global pressure, Argentina's space programme shifted focus to more civil activities, and in 1991, the National Space Activities Commission (CONAE) was created.
Technological and scientific impact of space programmes	• The Scientific and Technical Research Institute of Defence 1954 (CITEDEF) developed two Gradicom rockets (i.e., , Gradicom I in 2009 and Gradicom II in 2011) (European Space Policy Institute, 2021). • Developed and launched many satellites for scientific, telecommunications, EO and commercial use (e.g. LUSAT, NahuelSat, MuSat 1, SAC B, Naheul 1A, Veng SA, and many more). • Three launchpads exist (e.g., The Teófilo Tabanera Space Centre (CETT), The Manuel Belgrano Space Centre (CEMB), and The Punta Indio Space Centre (CEPI)). • Several Argentinian universities advances space education (i.e., University of Comahue (UComa), the National University of San Martin (UNSM), the University of Cordoba (UNC), and the National University of la Plata (UNLP) The Institute of Radio Astronomy (IAR) at UNLP houses two single disc radio telescopes and two antennas to study radio astronomy (European Space Policy Institute, 2021). • The UNLP also houses the Aerospace Technological Centre (CTA) and the Applied Mechanical Testing Group (GEMA), which participated in the development of the Argentine satellites SAC-B, SAC A, and SAC-D.
Policy and regulatory environment	• National Space Plan (PEN. 2016-2027), Geostationary Satellite Plan and the Plan Conectar guides satellite development, telecommunication activities (European Space Policy Institute, 2021). • CONAE coordinates the country's civil space activities and policy implementation. • Interinstitutional Council for Science and Technology (CICYT) coordinates common national S&T policies and reinforces linkages with the socio-economic sector. • Many other governmental entities are responsible for the conduct of space activities (i.e., National Atomic Energy Commission (CNEA), National Scientific and Technical Research Council (CONICET), Federal Council of S&T (COFECyT), National Communications Entity (ENACOM), National Institute of Industrial Technology (INTI) , and Ministry of Defence) (European Space Policy Institute, 2021).
Private sector and commercial space activity	• Argentina's private space sector is thriving, with companies such as Satellogic (satellite manufacture) and LIA Aerospace (small launcher development) establishing strong private sector connections).
Lessons Learned	• Leveraging both the air force and space agency enhances overall space industry: Argentina's air force and space agency collaboration maximises resources and expertise in the space sector, fostering technological advancement, national development, and international recognition in space endeavours.

LESSONS LEARNED &

RECOMMENDATIONS

This section reviews the key takeaways and recommendations based on our findings and experiences. It aims to distill the most important lessons learned and provide actionable recommendations for future endeavours.

Based on the analysis of space ecosystems across East Africa, Africa, and globally, there are valuable insights, best practices and innovative strategies that Kenya can adopt to further develop its space ecosystem effectively. Some of the key lessons identified in the comparative analysis are:

Government support and conducive policy environment:

Governmental backing through policies, funding, and strategic initiatives are essential for fostering sustained investment and growth in the space sector over the long term. This is demonstrated well through Egypt's government participation which prioritises its space sector by aligning space activities with national development goals. Nigeria, as one of the pioneering African countries with space policies in place, demonstrates the importance of having a robust policy framework, in order to successfully implement national space strategies. To foster the growth of Kenya's space ecosystem, it is essential to expedite the review of the Kenya Space Policy 2015 and the drafting of the Kenya Space Bill. The policy goals should prioritise industry needs. Additionally, KSA should consider seeking international technical assistance from organisations such as UNOOSA, for space law and policy development.

Partnerships and collaboration with key ecosystem players:

This lesson is exemplified in the analysis of countries like Rwanda, Sudan, South Africa, Turkey, and Kenya.

Collaborating with international agencies, academic institutions, and private sector entities enhances capabilities, facilitates knowledge exchange, and optimises resources to drive innovation and foster growth. Rwanda and South Africa have underscored the importance of forming strategic partnerships with international stakeholders to attract investment and secure financial backing for their space programmes. Similarly, Sudan, Turkey, and Kenya have demonstrated the significance of partnerships with academia, both domestically and internationally, for capacity building in the space sector.

Technology advancements and infrastructure development:

Ongoing investment in research, development, and innovation are critical to push the limits of technology and sustain global competitiveness. For both Argentina and South Africa, this has been a key development factor of their space sector with a history of satellite developments and launches, infrastructure supporting space technology applications (e.g., SANSA's Space Weather Centre; three launchpads in Argentina) and other space technology advancements developed for communication, navigation, Earth observation, scientific research, exploration, and global connectivity.

Skilled workforce:

Specialised skill development is vital for a thriving commercial sector, as demonstrated by South Africa.

National partnerships with academia, such as with Stellenbosch University's Electronics and Space Lab in South Africa (where students developed South Africa's first satellite) and international partnerships, such as Sudan's CubeSat programs (where students build CubeSat prototypes), as well as Uganda's participation in Japan's BIRDS program (where students build Uganda's first satellite), are examples of the efforts done to provide practical experience and meet industry needs. Kenya faces a skills gap in its space sector, primarily due to a misalignment between tertiary education and industry needs. While Kenya Space Agency (KSA) collaborates actively with stakeholders in academia, there is a significant need to increase industry participation and collaboration with Kenyan universities. This collaboration is essential to bridge the skills gap, ensuring that educational programmes align closely with the practical demands of the space industry and preparing students with relevant expertise for careers in the sector.

The insights above serve as a valuable foundation for fostering collaboration, driving innovation, and informing strategic decision-making within Kenya's space sector. As the country continues to expand its presence in the global space arena, leveraging the stakeholder relationships brought about by inter-university partnerships, industry networks, international research collaborations and industry-university attachments will be beneficial.

Stakeholder engagements also highlighted the following considerations for each IDIA goal:

- **Building Human Capital:** Strengthening collaboration and alignment between academia and industry is essential to bridge the skills gap in the industry.
- **Innovation Culture:** An "open-door" policy is needed for collaborative policy development, while capital incentives are essential to foster innovation.
- **Networking Assets:** There is a need to move beyond mere attendance at conferences towards tangible contributions to the field of space technologies used by industry.
- **Access to finance:** Encouraging investors to be less risk-averse towards investing in space technologies, by demonstrating their role in addressing developmental problems, will be key towards ensuring greater access to finance.
- **Equitable and inclusive participation:** Increased exposure and visibility of the space sector for marginalised groups is needed.

6

KENYAN SPACE SECTOR
APPENDICES

6.1. APPENDIX 1: THEORY OF CHANGE (ToC)

IDIA Goal	Activities	Outputs
Building Human Capital through the enhancement of research and innovation skills	• Identify awareness-based interventions during project • Engage stakeholders to identify areas that require Skills analysis and development programmes • Identify, map and foster the creation of inter-disciplinary pathways for existing skills into the space sector • Identify methods and assist space entrepreneurs to enhance their own skills, products and services	• **Ecosystem Maturity Assessment Report**: List of key existing awareness-based interventions • **Co-design Workshop**: Identify areas that require Skills analysis and development programmes • **Space Innovation Ecosystem Roadmap Report**: Interventions on the roadmap designed to foster the creation of inter-disciplinary pathways for existing skills in the space sector • **Ecosystem Maturity Assessment Report**: Highlighting areas to build on Human Capital and where skills development is required for the space sector • **Interventions prioritisation Report**: Space Incubation Programme for implementation in Phase 2
Ensuring accessibility of Finance and strengthening funding capacity	• Identify existing finance mechanism for entrepreneurs • Develop a robust list of financial and technical partners that are willing to provide finances to the private sector and research initiatives to grow the space sector • Identify and highlight linkages between finance institutions and space sector by looking at available local and global opportunities	• **Ecosystem Maturity Assessment Report**: Identified existing finance mechanisms for entrepreneurs + list of funders in the ecosystem • **Stakeholder Mapping and Analysis Report**: Robust list of financial and technical partners that are willing to provide finances to private sector and research initiatives to grow the space sector • **Stakeholder Mapping and Analysis Report / Space Innovation Ecosystem Roadmap Report**: Identified linkages between finance institutions and space sector

Outcome	Impact
• Increased adoption of space-based solutions among Kenyan human capital, driving local and global value creation. • Establishment of a proficient entrepreneurial community effectively leveraging space-based opportunities. • Heightened awareness and understanding of the commercial and socio-economic potential of space-based solutions. • Improved human capital prepared to adopt and implement space-based solutions effectively.	IMPACT: To establish an inclusive Kenyan Space Ecosystem aligned with the Kenyan Space Policy, promoting evidence-based decision making and empowering space entrepreneurs to deliver commercial solutions addressing national socio-economic development while eliminating barriers for excluded communities to access modern technology.
• Growth of new and existing SMMEs leveraging space-based technologies for expanded products and services within the innovation ecosystem. • Reduced risk in the sector, providing a clear return on investment horizon for institutional and individual investors in various space activities. • Establishment of an inclusive space ecosystem promoting gender and social inclusion, reshaping the narrative of women and marginalized groups in space-based entrepreneurship. • Identification of low-risk, high-potential use cases in response to sector needs, accompanied by the development of targeted financial models.	

IDIA Goal	Activities	Outputs
Nurturing a culture supportive of high-quality research, innovation and entrepreneurship	• Identify and develop initiatives that will enhance the culture of innovation existing in Kenya • Identify, and map key initiatives that will catalyse the advancement of space-based entrepreneurship • Identify and support key supportive markets and infrastructures that can enable a healthy environment for space entrepreneurs • Develop a clear incubation/acceleration programme to enable Kenyan space start-ups	• **Co-design Workshop** • **Space Innovation Ecosystem Roadmap Report**: Identified key initiatives that will catalyse the advancement of space-based entrepreneurship • **Ecosystem Maturity Assessment Report**: Identified supportive markets and infrastructure that can enable a healthy environment for space entrepreneurs • **Interventions Prioritisation Report**: Space Incubation Programme for implementation in Phase 2
Supporting coordinated networking assets that enable productive interconnectivity and contribution between different research and innovation stakeholders.	• Host an intervention co-design workshop to ensure collaboration with key stakeholders in intervention development • Invite relevant parties (leaders in industry, subject matter experts, youth, woman and marginalised groups) in the space sector to participate in co-design workshop • Highlight how initiatives created across all the ESGs are fit for purpose for KSA and users and align with KSA and national priority areas	• **Co-design Workshop** • **Stakeholder Mapping Report** • **Workshop Report** • **Workshop Report** : Attendance list • **Interventions prioritisation Report** : Identifying interventions that align with KSA priority areas

Outcome	Impact
• Establishment of a space entrepreneurship culture enhancing Kenya's ecosystem, boosting progress towards developmental objectives. • Formation of a thriving community of Kenyan space entrepreneurs, catalyzing national and global development, while establishing robust incubation and acceleration programs. • Successful space entrepreneurs driving commercial value and addressing socio-economic challenges effectively. • Participation of Kenyan space entrepreneurs in global startup programmes, expanding their influence internationally. • Growth of dedicated space entrepreneurs addressing local and global challenges, fostering innovation and adaptation. • Utilization of adjacent industry infrastructure to bolster the development of the space innovation ecosystem.	IMPACT: To establish an inclusive Kenyan Space Ecosystem aligned with the Kenyan Space Policy, promoting evidence-based decision making and empowering space entrepreneurs to deliver commercial solutions addressing national socio-economic development while eliminating barriers for excluded communities to access modern technology.
• Established network facilitating inclusive participation, finance, policy development, and market success in the emerging space sector. • Formation of a well-coordinated network involving market actors, aligning Kenya's space ecosystem with national and global activities and needs. • Ongoing input and engagement from market actors fostering the success of space-based solutions across industries and sectors at both national and global levels. • Identification of key stakeholders and collaboration strategy driving engagement. • Establishment of relationships with key actors and stakeholders.	

IDIA Goal	Activities	Outputs
Ensuring equitable and inclusive ecosystem governance and participation	• Build inclusive, equitable space innovation ecosystem on both the demand and supply side of space-solutions • Identify and design initiatives that recognise the women, youth and marginalised communities that can disproportionately benefit from greater access to space-based services • Design and develop GESI targeted initiatives/interventions across all the ESGs	• **Interventions Prioritisation Report**: Identified interventions that seek to build inclusive, equitable space innovation ecosystem on both the demand and supply side of space solutions. • **Space Innovation Ecosystem Roadmap Report**: Initiatives designed to recognise women, youth and marginalised communities • **Space Innovation Ecosystem Roadmap Report**: Design GESI targeted initiatives across all ESGs

Outcome	Impact
• Gender Equity/Equality and Social Inclusion integrated into the ecosystem, fostering successful entrepreneurs and solutions aligned with GESI principles. • Formation of a space ecosystem promoting gender and social inclusion while reshaping the narrative of marginalized groups in space-based entrepreneurship. • Early ecosystem activities promoting intentional access, participation, and prioritizing solutions benefiting women and marginalized groups. • Engagement of marginalized voices through identified mechanisms and pathways, leading to a contextually relevant strategy ensuring Gender Equity and Social Inclusion.	IMPACT: To establish an inclusive Kenyan Space Ecosystem aligned with the Kenyan Space Policy, promoting evidence-based decision making and empowering space entrepreneurs to deliver commercial solutions addressing national socio-economic development while eliminating barriers for excluded communities to access modern technology.

6.2. APPENDIX 2: GLOBAL, REGIONAL AND KENYAN SPACE CONTEXT

6.2.1. Global Space Context

As shown in Figure 11 below, the global space economy is expected to be worth approximately 1.8 trillion USD by 2035, more than doubling in value, from the 630 billion USD recorded in 2023 (World Economic Forum, 2024). It is anticipated that space-enabled technologies such as navigation and timing, Earth observation, communication, etc., will be the main drivers of this growth in the global space economy (World Economic Forum, 2024).

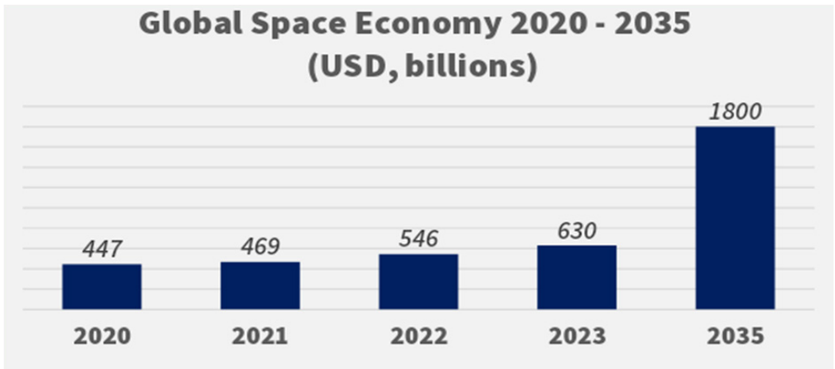


Figure 11: Value of the global space economy, 2020 – 2035 (projected)

From 2015, the space economy has experienced consecutive years of growth (Space Foundation, 2021). In recent years, it has reached an estimated 9% annual growth rate (World Economic Forum, 2024). It is anticipated to continue growing as more countries are increasing public and private investment in the space industry and leveraging space technology for their socioeconomic development.

Some key figures and trends in the global space economy include:

Launch Attempts:

In 2023, global launch activity reached an all-time high, with 223 launch attempts and a 95% success rate recorded (Space Foundation, 2024).

Launch Associated Costs:

Launch-associated costs have decreased by 10 times in the last 20 years (World Economic Forum, 2024), making satellite launches possible for more countries – this can be seen in the increase in launch activity in recent years.

Industry Involvements:

It is projected that by 2035 five industries will generate 60% of the global space economy, namely: food and beverage; supply chain and transport; digital communications; retail, consumer and lifestyle; and state-sponsored defense (World Economic Forum, 2024).

6.2.2. African Space Context

The African space industry is still in its infancy, with a majority of the continent's space agencies founded within the last 20 years. The African space economy is projected to grow and reach 22,64 billion USD by 2026, an approximate increase in growth of 16.16% from 2023 (Space in Africa, 2023). Although the allocated budget toward space activities across the continent decreased by 14.96% in 2023, from the 2022 budget, the total funding allocated reached 425,01 million USD (Space in Africa, 2023). This decline has been attributed to various, mainly, external factors such as the continuously rising and falling foreign exchange rates (Space in Africa, 2023).

Despite this budget decline, there have been many notable developments that the African region is spearheading in the space industry, some of these are:

South Africa - Development of the world's biggest radio telescope by 2024– the Square Kilometre Array.

Nigeria – The National Space Research and Development Agency (NASRDA) has launched 5 satellites since 2005.

Rwanda – Approved SpaceX's Starlink as a socio-economic initiative to bring connectivity services to remote areas using satellites.

The African Space Agency (AfSA) was established by the African Union in 2023, to promote space cooperation between member states and to work closely with the European Space Agency (ESA) to formulate the African Space Policy (Gopaldas, 2023). Figure 12 on the right showcases all the countries with space programmes in Africa.

Figure 12: Countries with space programmes/agencies in Africa

6.2.3. East African Space Context

Space initiatives in the East African Community are advancing, with an increase in satellite launches and collaborative efforts in the region - Kenya among those at the forefront of these initiatives. Being an ideal equatorial state gives Kenya a comparative advantage for a spaceport satellite launch facility. To date, there have been 59 satellites launched across 15 African countries, with Egypt and South Africa leading with 13 launches each (Space Hubs, 2024). Kenya, Ethiopia and Rwanda are leading with two satellites launched each, followed by Uganda and Rwanda with one each. These have been illustrated in Figure 13 below.

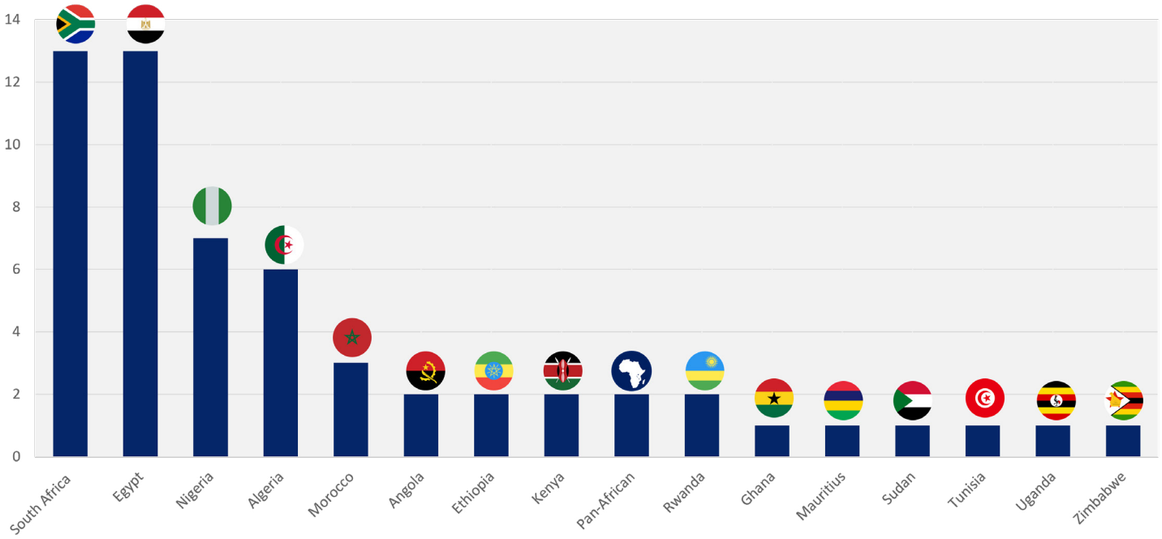


Figure 13: African countries that have launched satellites

It should be noted that majority of the satellites launched by African countries, particularly the emerging African space nations were nanosatellites (i.e. CubeSats that are 1-10 kg in mass) due to their lower development and launch costs.

Examples of such satellites include Taifa-1 (Kenya), Pearl AfricaSat-1 (Uganda), RwaSat-1 (Rwanda) etc.

In November 2023, ICT Ministers from various East African Community (EAC) nations, including Rwanda, South Sudan and Uganda gathered in Arusha, Tanzania, and agreed to develop a regional satellite that would serve to improve the efficiency of communication within the region (Space in Africa, 2023). The development of such a satellite encourages collaboration within the region and is anticipated to provide socio-economic benefits for all.

However, more mature space-faring nations like South Africa, Egypt and Nigeria etc., have successfully launched much larger satellites (i.e., microsatellites between 10-100 kg, minisatellites between 100-500 kg, and larger satellites, i.e., >500 kg in mass) into orbit. Some notable examples of these larger satellites are highlighted below:

- **Algeria:** AlSat-1 (2002), AlSat-2A (2010), AlSat-1B (2016), AlSat-2B (2016)
- **Egypt:** EgyptSat-1 (2007), EgyptSat-2 (2014), EgyptSat-A (2019)
- **Nigeria:** NigeriaSat-1 (2003), NigeriaSat-2 (2011), NigeriaSat-X (2011), NigComSat-1 (2007), NigComSat-1R (2011)
- **South Africa:** SUNSAT (1999), SumbandilaSat (2009)

6.2.4 Kenyan Space Context

Various developments have taken shape in the Kenyan space industry, advancing the industry and enabling the leveraging of space technology in other sectors. These have been captured in Figure 14 below.

*As **agriculture represents approximately 28% of the national GDP** (EU Global Action Plan 2022), Kenya has invested in the use of Earth Observation technologies for agricultural monitoring and aims to address various other SDGs using space and supporting technologies.*

The 2023 Kenyan space policy highlights the importance of international cooperation, capacity building, and technology transfer for the growth of Kenya's domestic space industry.

*According to Space in Africa 2021, Kenya has witnessed a **steady increase in its national space budget from 2018 with an average of 2.5 million USD** allocated towards space initiatives every year.*

*The **Luigi Broglio Space Centre, in Malindi, is Kenya's main space asset**. It is co-exploited with the Italian Space Agency and **served as an equatorial launch facility until 1988, culminating in 9 satellites launches** (EU Global Action Plan 2022). The centre now operates as a ground station for telemetry tracking and control (TT&C).*

*Kenya **launched its first operational Earth Observation satellite (Taifa-1) in April 2023**. The satellite aims to collect agricultural and environmental data, on floods, drought and wildfires, that authorities plan to use for disaster management and to combat food insecurity (Nacosti 2023).*

*The **emergence of numerous NewSpace private sector players** leading innovations in space technologies and services has transformed the industry in Kenya.*

Figure 14: Various developments of the Kenyan space industry

6.3. APPENDIX 3: IDIA GOAL PRIORITISATION

	Key Aim	Strengths	Challenges	Typical Key Actors	KSA considerations for Kenya IER	KSA considerations pertaining to IDIA Goal	Overall Rating
Building Human Capital	• Building informed **human capital**	• Encourages the **support of the development of innovation-enabling spaces.** • Prioritises the **delivery of training and support to the ecosystem.** • Ensure **alignment of research agenda to meet national/local needs and opportunities.** • Supports **training and mentorship** to build research capacity in new areas. • Considers the **participation of marginalised groups in innovation processes and research and research incentive mechanisms.**	• Only possible where there is a focus on eradicating **limitations in skills, knowledge or knowledge-sharing among partners in the ecosystem.** • **An environment that does not prioritise a national research agenda and implementation of research systems** • Talent pool that is not diverse, structured or financially capable to support innovation and research	• Academia • Research & Training Institutions • Government • Hubs • Incubators • Accelerators • CSOs/NGOs • Innovators	I. Ensure **inclusion and participation of private sector and start-ups**. II. Support the **start-up/innovation ecosystem in developing solutions to address local needs and gaps.** III. Increase **funding and finances** into the space innovation ecosystem. IV. Ensure that **KSA, for one, knows all the stakeholders acting in the ecosystem,** their capabilities, needs and gaps. **V. Facilitate the bringing together of stakeholders.** VI. Ensure that **local innovators are designing products for national priority areas.** **VII. Remove the siloed approach** within the ecosystem. VIII. Ensure **deepened uptake of existing/proven services and products**. IX. Facilitate the **inclusion of other key sectors.** X. Ensure there is human **capacity** within the ecosystem. XI. Look for ways to **build communities within the sector that support the growth of the sector.** **XII. Develop mechanisms that allow funders to gauge the potential of the market and ecosystem.**	• I • II • IV • V • VI • VII • IX • X • XI • XII	• 10
Access to Finance	• Ensuring **accessibility of finance** for innovation process	• Encourages the inclusion and experimentation with **innovative financing mechanism**. • **Endeavors to de-risk innovation** by adopting balanced portfolio approaches. • Prioritises **engagement of local actors in sourcing and selection of innovation investments.** • Looks to **support the investment towards advanced research** that supports innovation and invention.	• Gaining **buy-in** from financial sector. • **Lack of and slow growth of diverse funding mechanisms.** • **Value for Money not clear** and uncertain for investors. • **Prejudiced funding distributions.** • **Little appetite** in funding towards innovation and research	• Financial Institutions • Private Companies • Government • CSOs/NGOs • Start-ups		• I • II • III • IV • V • VII • IX • X • XII	• 9
Supportive Markets and Infrastructure	• Establishing supportive research, **markets**, energy, transport, and communications **infrastructure**	• Ensures that **innovation actors and their activities are clustered within specific areas**. • Ensures that **market is shaped, and pathways are clear**. • Prioritises **market access**. • Encourages the **strong linkages and communication between stakeholders** in support for enabling research and innovation. • Seeks to **establish infrastructure** that supports research and innovation.	• **The lack of adequate and reliable infrastructure.** • **Low innovation uptake.** • **High barriers to market entry.** • **Low diffusion of research** due to disconnects among R&D institutions and innovators. • **No infrastructure** to enable innovation and research. • **Siloed approach**	• Government • Private Sector • Hubs • Accelerators • Research, Training and Knowledge Institutions		• I • IV • V • VII • VIII • IX • XI	• 7

	Key Aim	Strengths	Challenges
Policies and Regulations	• Creating enabling **policies and regulations**	• Ensures there is **policy that encourages multi-sectoral, multidisciplinary policy frameworks** for innovation. • Ensures that **policy and regulations do not hinder collaboration, partnerships and an innovation culture.** • Ensures that **policies strengthen collaboration between academia, private sector, government and civil society.** • Takes **system approach at all levels to strengthen research capacity** within the ecosystem.	• **Policies that are not fit for purpose in terms of enabling innovation, research and collaborations amongst innovation actors.** • **No clear role for government to play.** • **No policies at all** to enable the ecosystem.
Innovation Culture	• Nurturing a **culture supportive of innovation** and entrepreneurship	• Ensures there is **multi-stakeholder dialogue, knowledge sharing and capacity development for and between partners.** • Seeks to **facilitate the formation of multiple pronged relationships** in the ecosystem. • Looks to **support and promote a culture and mindset that incorporates innovation**. • Prioritises the **facilitation of learning opportunities that are inclusive**. • **Encourages the support of South-to-South research collaboration.**	• Environments that **do not understand innovation and an innovative mindset.** • A **siloed ecosystem**. • Ecosystem **prioritises the short-term as opposed to planning for the long-term**. • **Individually driven research culture among actors.**
Networking Assets	• Supporting **networking assets** that enable productive relationships between different actors	• Looks to **encourage investing in multi-pronged connections amongst actors**. • Encourages **funding towards Entrepreneur Support Organisations and Innovation Intermediaries**. • Prioritises **mapping ecosystem actors and using network analysis techniques to elevate the most impactful connections**. • Ensures the **coordination of research management systems**. • Prioritises **matching of supply and demand within the ecosystem**.	• A **siloed ecosystem.** • **Lack of awareness** amongst actors of their counterparts. • **Lack of clarity around Intellectual Property Rights**. • **Competition with externally-designed networking interventions that undermine ecosystem productivity and inclusion.**

	Typical Key Actors	KSA considerations for Kenya IER	KSA considerations pertaining to IDIA Goal	Overall Rating
Policies and Regulations	• All government offices and levels • Research Institutions • Private Sector • Civil Society	I. Ensure **inclusion and participation of private sector and start-ups**. II. Support the **start-up/innovation ecosystem in developing solutions to address local needs and gaps.** III. Increase **funding and finances** into the space innovation ecosystem. IV. Ensure that **KSA, for one, knows all the stakeholders acting in the ecosystem,** their capabilities, needs and gaps. **V. Facilitate the bringing together of stakeholders.** VI. Ensure that **local innovators are designing products for national priority areas.** **VII. Remove the siloed approach** within the ecosystem. VIII. Ensure **deepened uptake of existing/proven services and products**. IX. Facilitate the **inclusion of other key sectors.** X. Ensure there is human **capacity** within the ecosystem. XI. Look for ways to **build communities within the sector that support the growth of the sector.** **XII. Develop mechanisms that allow funders to gauge the potential of the market and ecosystem.**	• I • III • V • VII • IX • X • XI	• 7
Innovation Culture	• Government • Research & Training Institutions • Private Sector • Hubs/Incubators • CSOs/NGOs		• I • II • IV • V • VI • VII • VIII • IX • X • XI • XII	• 11
Networking Assets	• Government • Research Institutions • Private Sector • Hubs/Incubators • Innovators • Civil Society		• I • II • III • IV • V • VI • VII • VIII • IX • XI • XII	• 11

	Key Aim	Strengths	Challenges
Equitable and Inclusive Participation	• Ensuring **equitable and inclusive ecosystem** governance and participation	• Looks to ensure **donors shift position from solution providers to solution enablers**. • Prioritises **addressing power and inclusion imbalances within the ecosystem by enabling representation, consultation and incorporating decision-makers from all parts** of the ecosystem and society. • Ensures **community and target market participation, uptake and demand**. • Prioritises **diversity within the innovator and research talent pool** to give all people an equal opportunity to participate in the ecosystem. • Ensure that **metrics used to evaluate success and failure are diversified**.	• **Environments that do not intentionally include marginalised groups in the talent pool.** • Strengthening **efforts that do not address the power imbalances, inequalities in the society** and unconsciously exacerbate the challenges.
Pathways to Scale	• Creating **smoother pathways to scale** for specific innovation	• Prioritises the **scaling of products and services through public sector, private sector or partnerships**. • Ensures that the society is **enabling innovation**. • Ensures that **there is community uptake and demand.** • Prioritises **diversity in the talent pool of innovators and metrics used to evaluate success and failure.**	• Environments that **have little or no incentives to seek out new innovations, pathways, coordination**. • Skewed **emphasis on supply compared to demand**.
Collective Approach	• Mobilising a **collective ecosystem approach** to address a particular development challenge	• Ensures the **coordination and mobilisation of actors in the ecosystem to organise around a particular issue to work towards a solution.** • Prioritises the **incorporation of a macro-level approach to all areas that support innovation.** • Adopts **a micro-level approach in situations where new innovations, practices or lifestyles are emerging or may take hold**.	• Environments that **lack of visibility, coordination, or alignment among actors**. • **Lack of diversity and inclusion of important actors.** • A heavy focus **on positioning actors around addressing complex or controversial issues.**

	Typical Key Actors	KSA considerations for Kenya IER	KSA considerations pertaining to IDIA Goal	Overall Rating
Equitable and Inclusive Participation	• Government • Civil Society • Research Institutions • Private Companies • Range of actors	I. Ensure **inclusion and participation of private sector and start-ups**. II. Support the **start-up/innovation ecosystem in developing solutions to address local needs and gaps.** III. Increase **funding and finances** into the space innovation ecosystem. IV. Ensure that **KSA, for one, knows all the stakeholders acting in the ecosystem,** their capabilities, needs and gaps. **V. Facilitate the bringing together of stakeholders.** VI. Ensure that **local innovators are designing products for national priority areas.** **VII. Remove the siloed approach** within the ecosystem. VIII. Ensure **deepened uptake of existing/proven services and products**. IX. Facilitate the **inclusion of other key sectors.** X. Ensure there is human **capacity** within the ecosystem. XI. Look for ways to **build communities within the sector that support the growth of the sector.** **XII. Develop mechanisms that allow funders to gauge the potential of the market and ecosystem.**	• I • II • IV • V • VI • VII • VIII • IX • X • XI • XII	• 11
Pathways to Scale	• Government • Range of partners		• I • II • V • VI • VII • VIII • IX • X • XI	• 9
Collective Approach	• Range of actors		• I • II • V • IX • XI	• 5

6.4. APPENDIX 4: ECOSYSTEM MATURITY ASSESSMENT METHODOLOGY

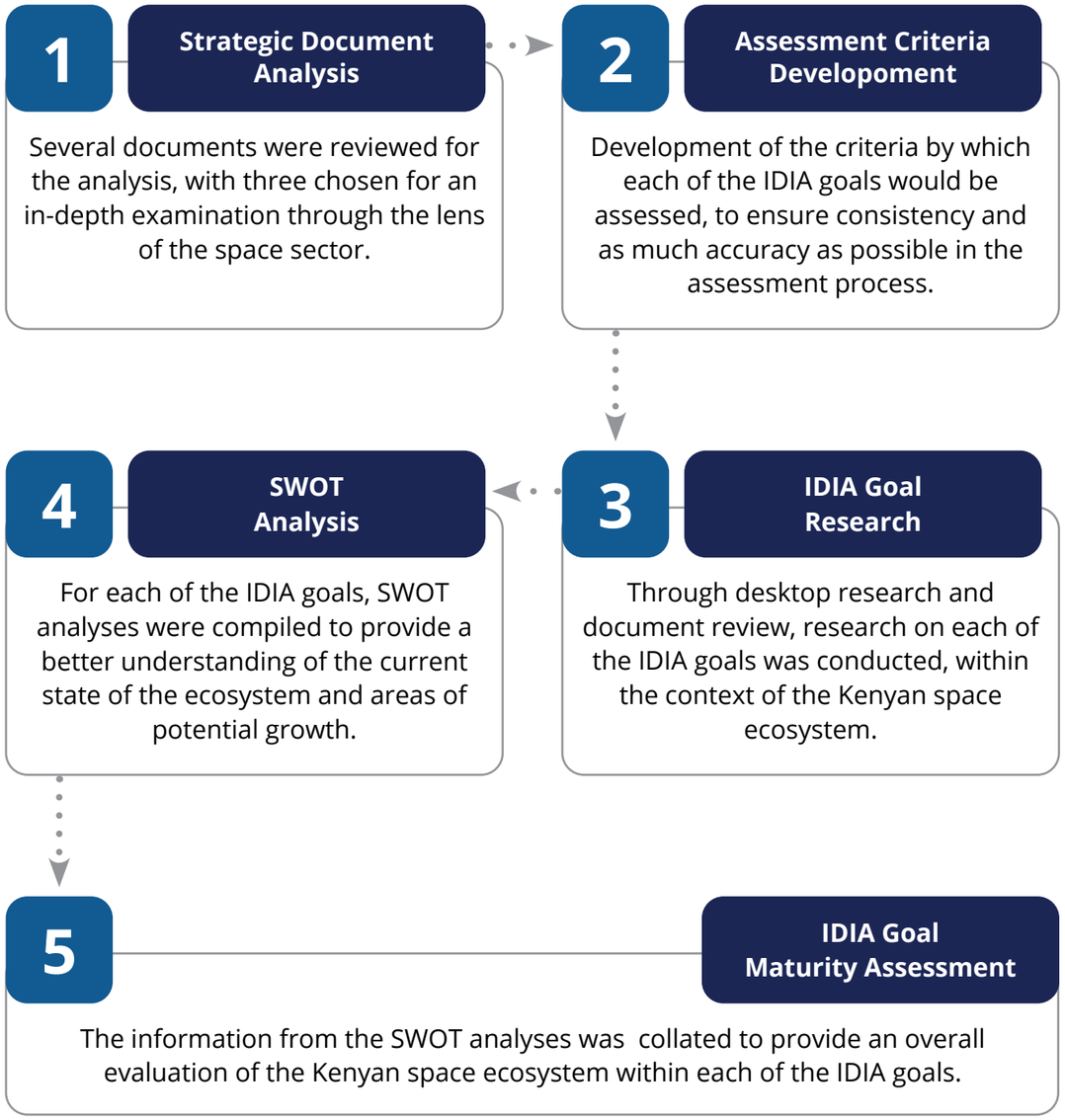


Figure 15: Ecosystem maturity assessment approach and methodology

6.4.1. Strategic Document Analysis

The first activity of the ecosystem maturity assessment involved the analysis of several strategic documents to gain a contextual understanding of Kenya's national priorities and how these may overlap with space-related priorities.

From the preliminary analysis, three key documents, namely, the **Kenya Space Agency Strategic Plan 2023-2027, The Kenya Innovation Masterplan, and Vision 2030** were analysed in more depth. See Figure 16 below:

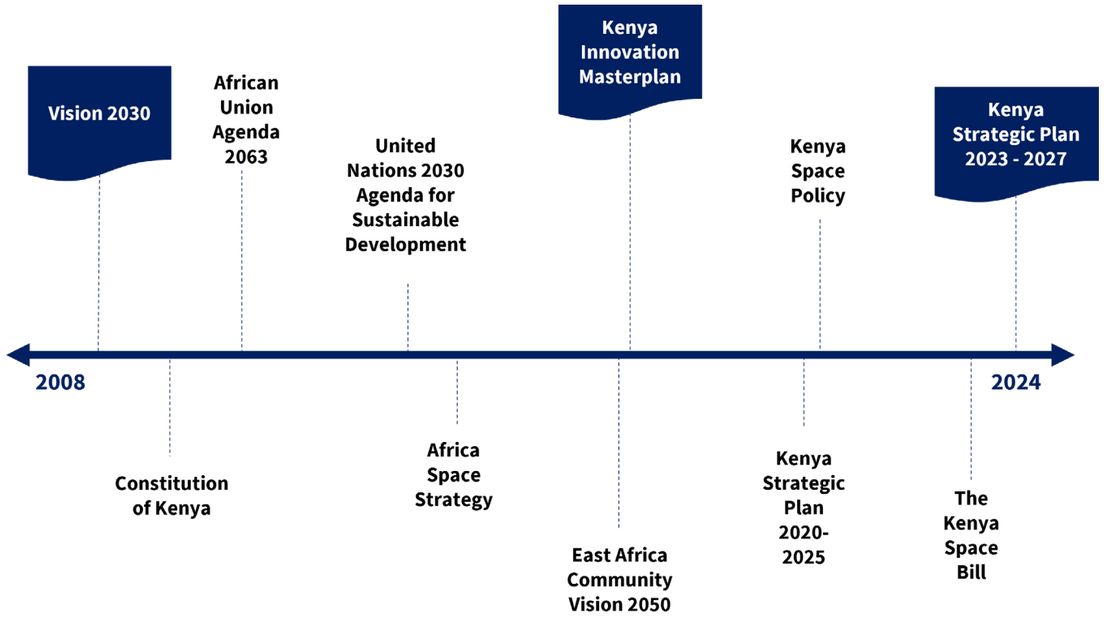


Figure 16: Timeline of the conception of several key strategic documents relating to the Kenyan and regional context

6.4.2. Kenya Vision 2030

The Space sector has the potential to contribute to Kenya achieving its Vision 2030.

The Kenya Vision 2030 is the long-term development blueprint for the country adopted in 2008, aiming to transform Kenya into, "a newly-industrializing, middle-income country providing a high quality of life to all its citizens in a clean and secure environment". The Kenya Vision 2030 is implemented through successive five-year Medium-Term Plans (MTPs). The MTP IV (2023-2027) is aligned to the Bottom-Up Economic Transformation Agenda (BETA) whose key objectives are to: bring down the cost of living; eradicate hunger; create jobs; expand the tax base; improve foreign exchange balances; and achieve inclusive growth. To achieve these, five core pillars of BETA were identified, namely: agriculture; micro, small and medium enterprise (MSME) Economy; housing and settlement; healthcare; and digital superhighway and creative economy. These pillars have guided the identification of programmes and projects in the following MTP IV sectors: Finance and Production; Infrastructure; Social; Environment and Natural Resources; and Governance and Public Administration.

GODAN Global Open Data for Agriculture & Nutrition

LocateIT Limited Whatever, Whenever, Wherever

ramani

esri Eastern Africa THE SCIENCE OF WHERE

CANSAT KENYA

agriBORA

Digital Earth AFRICA

AAC CLYDE SPACE

SAYARI LABS

OAKAR SERVICES Think Geospatial Solutions

Geoid TECHNOLOGIES LTD

Finance and production

The key priorities and interventions in the finance and production sector focus on livestock (comprising leather and leather products and dairy); crops (comprising tea), edible oils, rice; textile and apparel; and construction/building materials.

The following space technology applications can be used to meet the goals of each sector which cut across all IDIA goals analysed:

- Livestock and crop monitoring and management using space-based imagery.
- Natural resource managements using satellite data.

The following space technology applications can be used to meet the goals of each sector which cut across all IDIA goals analysed:

Infrastructure

The infrastructure sector seeks to: enhance transport connectivity by constructing new roads, maintaining rural and urban roads, rail, air and seaport facilities and services; expand communication and broadcasting systems; and promote development of energy generation and distribution by increasing investments in green energy.

- Satellite imagery and remote sensing data can aid in infrastructure planning.
- Satellite networks can provide reliable connectivity for telecommunication services, internet access, and broadcasting.

Social

The social sector identifies seven key priority areas, namely: Universal Health Coverage (UHC); Social Protection; Human Capital Development; Science Technology and Innovation; Digitalisation; Economic Empowerment; and Population and Development.

- Telemedicine and remote healthcare.
- Disaster Response and Management.
- Earth observation and environmental monitoring.
- Satellite imagery and geospatial data can support urban planning, infrastructure development, and land use management.

Environmental and Natural Resources

The sector focuses on natural resource conservation, restoration and management; sustainable waste management and pollution control; sustainable exploitation of natural resources and blue economy; and tourism promotion and marketing.

- Forest monitoring and management.
- Water resource management.
- Environment pollution monitoring.
- Fisheries monitoring.
- Satellite remote sensing can assist in mineral exploration, resource mapping, and environmental impact assessments.

Governance and Public Administration

The governance and public administration sector prioritizes strengthening of security capabilities through recruitment of additional police, prison and military officers and expansion of prison, police and military infrastructure and equipment.

- Remote Sensing for Security Operations.
- Border Security and Monitoring.
- Crisis Monitoring and Management.
- Geospatial Data for Infrastructure Security.

6.4.3. The Kenya Innovation Masterplan

The Space sector can capitalise on the opportunities outlined in the Kenya Innovation Masterplan.

The Kenya Innovation Masterplan is a 10-year innovation masterplan which seeks to propose a structured approach towards Kenya's innovation goals and prioritisation over the next 10 years . Built around the five pillars of Human Capital, Access to Finance, Access to Market, Infrastructure and Policy.

SERAPHIM

FOUNDERS FACTORY.

KSA KENYA SPACE AGENCY *Possibilities beyond our skies*

Kenia Kenya National Innovation Agency

PKNU KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY TECHNOLOGY FOR DEVELOPMENT

KONZA Technopolis

HARAMBEE

UNIVERSITY OF NAIROBI

Strathmore UNIVERSITY

Human Capital

This pillar refers to the efforts to develop relevant skills and experience among the population for quality output production in the knowledge economy. Improving the capacity of training institutions in the country to better support generation and commercialization of innovation is central to this pillar.

Opportunities that the Space sector can capitalise on:

- **Innovation Diffusion:** Creating awareness of the Space sector and the opportunities that lie there.
- **Market Linkages:** Linking Academia and industry for the purpose of collaboration on Space projects.
- **Generational Shift:** Demonstrate how the Space sector can support venture-based programs.

Access to Finance

This pillar refers to funding required to support the successful operation of the national innovation ecosystem. This includes the production and commercialisation of the outputs of the knowledge economy. Increasing the pool of funds available to stakeholders within the national innovation ecosystem is essential to the long-term success of the knowledge economy.

- **Systemic Innovation Funding:** Encourage private sector to fund innovation by demonstrating the benefits of Space technology to them.
- **Investment Assessments:** Adopt the the investment assessments methods and tailor it for the Space context.

Access to Market

This pillar refers to finding opportunities for generation of commercial value from the outputs of the knowledge economy. This includes finding, growing and maintaining commercial relationships. The success of the knowledge economy will depend on the ability to create new markets for the outputs of the national innovation ecosystem.

Opportunities that the Space sector can capitalise on:

- **Preferential Market Access:** Lobby for Space technologies to be part of preferential procurement schemes.
- **Lack of Awareness:** Create awareness among the Space sector on trade agreements that provide opportunities.
- **Accessibility:** Encourage the Space sector to adopt digital technologies to increase visibility.

Infrastructure

This pillar refers to physical and virtual solutions that support the ability of actors within the knowledge economy to produce quality outputs. This includes physical infrastructure such as information, communication and technology (ICT) equipment and services. Physical spaces that can increase interaction of stakeholders and offer facilities for the production and commercialisation of knowledge are also an essential part of this pillar.

- **Centers of Excellence:** Investigate the viability of a Space sector Centre of Excellence.
- **Central Innovation Repository:** Create a repository for promising Space innovations.
- **Knowledge Transfer:** Develop sector specific knowledge transfer systems.

Policy

This pillar refers to laws and regulations that provide guidelines within the innovation ecosystem. These are essential elements to encourage the participation of stakeholders who would make investments of human and financial capital in the national innovation ecosystem to promote the generation, protection and dissemination of knowledge outputs.

- **Innovation Gap:** Support counties develop their innovation policies by adding their voice.
- **Policy Awareness:** Participate in channels to proactively engage on policy.
- **Idea exchange:** Participate in policy discussions related to IP.

6.4.4. Kenya Space Agency Strategic Plan 2023-2027

Aligning the KSA Strategic Plan key results areas to the IDIA framework allows for the development of targeted interventions during the roadmap development.

The Agency's Strategic Plan for 2023-2027 is a blueprint of operations and outlines a trajectory for fostering Kenya's emerging space economy, aiming to significantly enhance the country's socioeconomic development and direct the Agency towards achieving its vision of "Effective utilisation of space capabilities for national development." The strategic issues highlighted in the strategic plan arose from situational and stakeholder analysis and have been identified as: inadequate coordination and governance of the space sector, limited technical capacity, infrastructure, and research & development in the space sector; insufficient resourcing and investment in the space sector; low utilisation and participation in the space ecosystem; and inadequate corporate positioning and sustainability. Each of these strategic issues has one or more key result areas (KRAs) mapped to it, namely; coordination and regulation of space activities; national space capability development; utilisation of space services and technology; space research, innovation and development; resource mobilisation; and strengthening institutional capacity with each KRA having several strategies aimed at addressing them.

ENGINEERS BOARD OF KENYA
Enhancing Professionalism

DeKUT Library
Dedan Kimathi University of Technology
Better Life Through Technology

KENYA SPACE AGENCY
Possibilities beyond our skies

Agenzia Spaziale Italiana

Institution of Surveyors of Kenya

National Commission for Science, Technology and Innovation

NATIONAL RESEARCH FUND

Kenya National Innovation Agency

MURANG'A COUNTY GOVERNMENT

Taita Taveta University

LEO SKY AFRICA

REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT

Coordination and Regulation of Space Activities

- Coordinate the development and implementation of Space policies.
- Coordinate the development and implementation of legal frameworks.
- Provide advisory services and recommendations on space- related matters.
- Capacity building on compliance with space policies and laws.

National space Capability Development

- Development of space-related infrastructure.
- Development of data infrastructure, facilities, and applications.
- Establishment of Centres of Excellence.
- Promoting the growth of the space ecosystem.

Utilisation of space services and technologies

- Undertake pilot projects to develop space-related tools and applications.
- Develop and implement data governance frameworks.
- Awareness creation on the utility and benefits of space science and technology.
- Facilitate trainings on space-related disciplines.

Space Research, Innovation, and Development

- Promote Research and Development in Space-related fields.
- Support development of innovations and inventions.
- Establish space research missions and collaborations in space-related fields.

Resource Mobilisation

- Liaise with relevant government agencies to allocate resources to space programmes
- Regional and International engagements.
- Undertake revenue-generating activities
- Establish a space industry development fund.

Strengthening Institutional Capacity

- Recruitment, Training and development of staff.
- Establish monitoring and evaluation systems.
- Acquire assets and infrastructure.
- Implement quality management systems .
- Improve public outreach and awareness initiatives and enhance stakeholder engagement.
- Engage in Corporate Social Responsibility activities.

Building Human Capital

Access to Finance

Innovation Culture

Networking Assets

Equitable & Inclusive Participation

6.5. APPENDIX 5: IDIA GOAL MATURITY LEVEL BREAKDOWN

BUILDING HUMAN CAPITAL

Latent	Nascent	Forming	Establishing	Established
• Limited or no specialised space-focused training programmes and capacity-building collaboration among universities and research institutes. • Low interest in pursuing space-related studies. • Limited or no institutional infrastructure such as incubators, hubs, and accelerators supporting human capital development. • Minimal or non-existent government policies and events supporting human capital development in the space sector.	• A few specialised space-focused training programmes with limited collaboration on capacity building initiatives. • Early-stage establishment of infrastructure like. incubators/hubs accelerators). • Increasing number of students and professionals pursuing space-related fields like science and engineering. • Initial government policies are emerging to support human capital development in the space sector. • Increasing number of networking platforms and events, at a national-level, facilitating knowledge exchange.	• **Established, specialised space programmes and courses supporting skills development** with **local collaboration on capacity building initiatives.** • **A few innovation centres or hubs with active industry-academia engagement.** • **Significant number of students and young professionals pursuing space-related fields**. • **Strong government policies supporting human capital development in the space sector.** • **Regular events and conferences facilitating knowledge exchange and robust networking.** • **Numerous internships, apprenticeships, and collaborative projects involving industry and educational institutions.**	• Regionally reputable, comprehensive space programmes at universities supporting skills development with some international exposure. • Multiple developed innovation centres and hubs with strong industry-academia engagement. • High interest in space-related fields among students and young professionals, attracting international talent into the ecosystem. • Proactive government policies providing funding and grants for human capital development. • Continuous events and conferences facilitating knowledge exchange and regional networking. • Extensive internships, apprenticeships, with deeply sustained partnerships and collaborative projects between industry and academia.	• Globally recognised and comprehensive space programmes at universities, supporting skills development with international exposure and cutting-edge R&D collaborations. • Over 10 world-class innovation centres or hubs with strong industry-academia engagement. • Continuous inflow of students and professionals attracting international talent, investment, and partnerships. • Pioneering government policies providing substantial, continuous funding and incentives for human capital development. • Continuous events and conferences facilitating knowledge exchange with internationally integrated networks. • Symbiotic industry-academia engagement through internships, apprenticeships, and collaborative projects driving innovation, which positively impacts economic growth, job creation, and quality of life.

ACCESS TO FINANCE

Latent

- Limited, or no, access to funding sources like venture capital, angel investors, and government grants.
- Absence of innovative funding mechanisms for marginalised groups and women.
- Low investor risk appetite for early-stage start-ups or capital-intensive projects.
- Low investment attractiveness due to unfavourable policies, political instability, or geographical disadvantages.

Nascent

- A few venture capital firms, angel investors, government grants, and corporate venture arms.
- A few financial institutions offering innovation-focused loans and advisory services with minimal discrimination.
- Active crowdfunding platforms and seed funding opportunities in existence.
- Presence of incubators and accelerators providing funding and mentorship, backed by government and private sector initiatives.
- Increasing investor willingness to fund early-stage start-ups, with the country ranking in the top 10 in foreign development investment (FDI) regionally.

Forming

- **Numerous venture capital firms, angel investors, government grants, and corporate venture arms.**
- **Specialised services for start-ups and innovation-driven enterprises, including dedicated funding programmes and a seamless financial ecosystem supporting innovation.**
- **Well-developed crowdfunding platforms and ample seed, early-stage, and growth-stage funding opportunities.**
- **Numerous incubators, accelerators, and innovation hubs offering funding, mentorship, and resources with active government and private sector collaboration.**
- **High investor risk appetite and strong investment culture, with the region ranking in the top 5 for FDI regionally.**

Establishing

- Numerous venture capital firms, angel investors, government grants, and corporate venture arms, backed by financial institutions with dedicated innovation funding programmes.
- A strong network of seed, early-stage, and growth-stage funding opportunities is available.
- Numerous incubators, accelerators, and innovation hubs offering funding, mentorship, and resources, backed by strong government and private sector collaboration.
- A broad base of investors with a strong investment culture supporting early-stage start-ups and cutting-edge technologies.
- The nation ranks in the top 3 regionally for FDI, with a well-integrated financial ecosystem and continuous capital flow supporting innovation from ideation to commercialisation.

Established

- Diverse funding across all stages of innovation from domestic and international investors and a highly competitive landscape.
- Fully integrated and seamless financial ecosystem with strong collaboration among all stakeholders.
- Tailored advanced services and innovative financial instruments supporting start-ups.
- Globally recognised incubators, accelerators, and innovation hubs offering substantial funding.
- Effective government policies and private sector initiatives enhancing access to finance.
- A culture of embracing innovation-related risks, supported by robust risk mitigation mechanisms and diversified investment portfolios, is prevalent.
- High investment attractiveness, ranking 1st in the region for FDI and top 20 globally, contributing significantly to economic growth and societal well-being.

INNOVATION CULTURE

Latent

- Minimal awareness of innovation's importance and limited initiatives to promote it.
- Limited or no educational programmes focused on technology, innovation, and entrepreneurship.
- Limited or no awards, grants, or competitions to encourage innovative efforts.
- Lack of dedicated institutions and minimal government policies promoting innovation.
- Limited or no networking and idea exchange opportunities among innovators.

Nascent

- Emerging recognition of innovation's importance, with initial national campaigns and promotional activities in place.
- Introduction of courses focusing on technology, innovation, and entrepreneurship.
- Initiation of awards, grants, and competitions to stimulate innovative endeavours.
- Establishment of early-stage institutions and government initiatives to bolster innovation.
- Emerging opportunities for collaboration and networking among innovators, facilitated by frequent events, workshops, and idea exchange platforms.

Forming

- **Increasing awareness of the importance of innovation through ongoing national campaigns and promotional activities.**
- **Established courses and programmes tailored to technology, innovation, and entrepreneurship.**
- **Substantial awards, grants, and competitions to incentivise innovation with multiple initiatives established to support and enhance innovation.**
- **Regular opportunities for collaboration and networking among innovators with numerous events, workshops, and platforms.**
- **Growing integration of innovation into the national culture with increasing acceptance and celebration of innovative thinking.**

Establishing

- Wide-ranging recognition innovation's importance, supported by ongoing national campaigns.
- Well-established educational programmes offering comprehensive training in innovative skills.
- Significant recognition and incentives for innovative efforts, including awards, grants, and competitions with multiple institutions dedicated to supporting innovation, backed by robust government initiatives and policies.
- Regular collaboration and networking opportunities for innovators through events, workshops, and platforms for idea exchange.
- Deep integration of innovation into the national culture, with strong societal acceptance and celebration of innovative thinking, along with effective partnerships to support innovation.

Established

- Wide-ranging awareness of innovation's importance, supported by highly effective national campaigns.
- Top-tier educational programmes emphasising innovation.
- Universal recognition and incentives for innovative endeavours, including prestigious awards and grants.
- Presence of numerous leading institutions dedicated to innovation, backed by exemplary government initiatives.
- Seamless collaboration among innovators facilitated by global events and platforms.
- Integration of innovation into national culture, celebrated across societal sectors.
- Effective public-private partnerships recognised as exemplary practices in fostering innovation.

NETWORKING ASSETS

Latent	Nascent	Forming	Establishing	Established
• Minimal or no formal infrastructure and dedicated spaces for innovators to network and collaborate. • Infrequent or non-existent networking events, meetups, and conferences. • Limited platforms for connecting innovators, entrepreneurs, and investors, with low engagement among key stakeholders. • Poorly established communication channels hindering information dissemination about networking opportunities.	• Initial development of infrastructure and establishment of dedicated spaces for innovators. • Increasing number of networking events, meetups, and conferences. • Emerging platforms facilitating connections between innovators, entrepreneurs, and investors, with increasing engagement. • Development of basic communication channels for disseminating information about networking opportunities. • Introduction of early-stage support programmes like incubators, accelerators, mentorship, and advisory programs to facilitate connections among innovators.	• **Well-developed infrastructure and multiple dedicated spaces for innovators to collaborate.** • **Well-established platforms for connecting innovators, entrepreneurs, and investors, with high engagement. Regular and diverse networking events, meetups, and conferences.** • **Robust communication channels for disseminating information and widely promoting networking opportunities.** • **Numerous support programmes with strong networking components, including established mentorship and advisory services.** • **Active collaboration and joint projects between academia, industry, government, and entrepreneurs promoting innovation and networking.**	• Highly advanced infrastructure and numerous well-equipped spaces for innovators to collaborate. • Frequent, high-quality networking events, meetups, and conferences attracting diverse participants. • Sophisticated platforms for connecting innovators, entrepreneurs, and investors, with very high engagement. • Highly effective communication channels and broad promotion of networking opportunities through multiple media. • Extensive support programs with integral networking components, mentorship and advisory services. • Deep and sustained collaboration between academia, industry, government, and entrepreneurs, with regular joint projects an active participation in international networks and frequent engagement with global innovation hubs.	• World-class infrastructure and numerous state-of-the-art spaces for global collaboration among innovators. • Continuous, top-tier networking events, meetups, and conferences attracting global participants. • Highly sophisticated and integrated platforms for global connections among innovators, entrepreneurs, and investors. • Universal and deeply embedded engagement and seamless interaction across all sectors. • Exemplary communication channels with comprehensive media strategies. • World-leading support programmes with highly effective networking components and impactful global mentorship. • Leadership in international networks, high-impact engagement with global innovation hubs, and significant contributions to sustainable development and societal well-being.

EQUITABLE & INCLUSIVE PARTICIPATION

Latent	Nascent	Forming	Establishing	Established
• Lack of formal Diversity, Equity and Inclusion (DEI) policies and minimal representation of diverse groups in governance. • Low awareness of DEI importance and few advocacy initiatives promoting equity and inclusion. • Limited access to resources and opportunities for underrepresented groups, with few targeted support programmes. • Low engagement and participation from diverse groups in innovation activities, with minimal involvement in decision-making processes.	• **Initial development of DEI policies and some representation of diverse groups in governance bodies.** • **Growing awareness of DEI importance and emerging advocacy groups promoting equity and inclusion.** • **Increasing access to resources and opportunities for underrepresented groups, with new targeted support programmes.** • **Moderate engagement from diverse groups in innovation activities and initial efforts to involve them in decision-making processes.**	• Well-established policies and frameworks promoting DEI with significant representation of diverse groups in governance bodies. • High awareness of DEI importance and active advocacy groups promoting equity and inclusion. • Broad access to resources and multiple targeted programmes for underrepresented groups, supporting diverse innovators and entrepreneurs. • High engagement and participation from diverse groups in innovation activities, with active involvement in decision-making processes. • Regular monitoring and evaluation of DEI policies using data and metrics to assess and improve efforts.	• Comprehensive policies promoting DEI with strong representation in governance. • Universal awareness of DEI importance and highly effective advocacy initiatives. • Widespread access to resources and extensive targeted programmes for underrepresented groups. • Very high engagement from diverse groups in innovation activities with deep involvement in decision-making. • Advanced monitoring systems for data-driven improvement of DEI efforts. • Strong institutional support with dedicated offices focusing on promoting DEI.	• Exemplary policies and frameworks for DEI, setting global benchmarks. • Full and equitable representation of diverse groups in governance. • Deep awareness of DEI importance, with influential advocacy initiatives. • Universal access to resources and impactful programmes for underrepresented groups. • Maximum engagement from diverse groups, with integration in decision-making. • State-of-the-art monitoring for data-driven improvement of DEI efforts. • Unwavering institutional support with dedicated departments for DEI promotion. • Global leadership in DEI, influencing global standards and contributing to sustainable development.

6.6. APPENDIX 6: BENCHMARKING

6.6.1. Benchmarking Methodology

The benchmarking exercise was completed through three activities outlined in Figure 17 below:

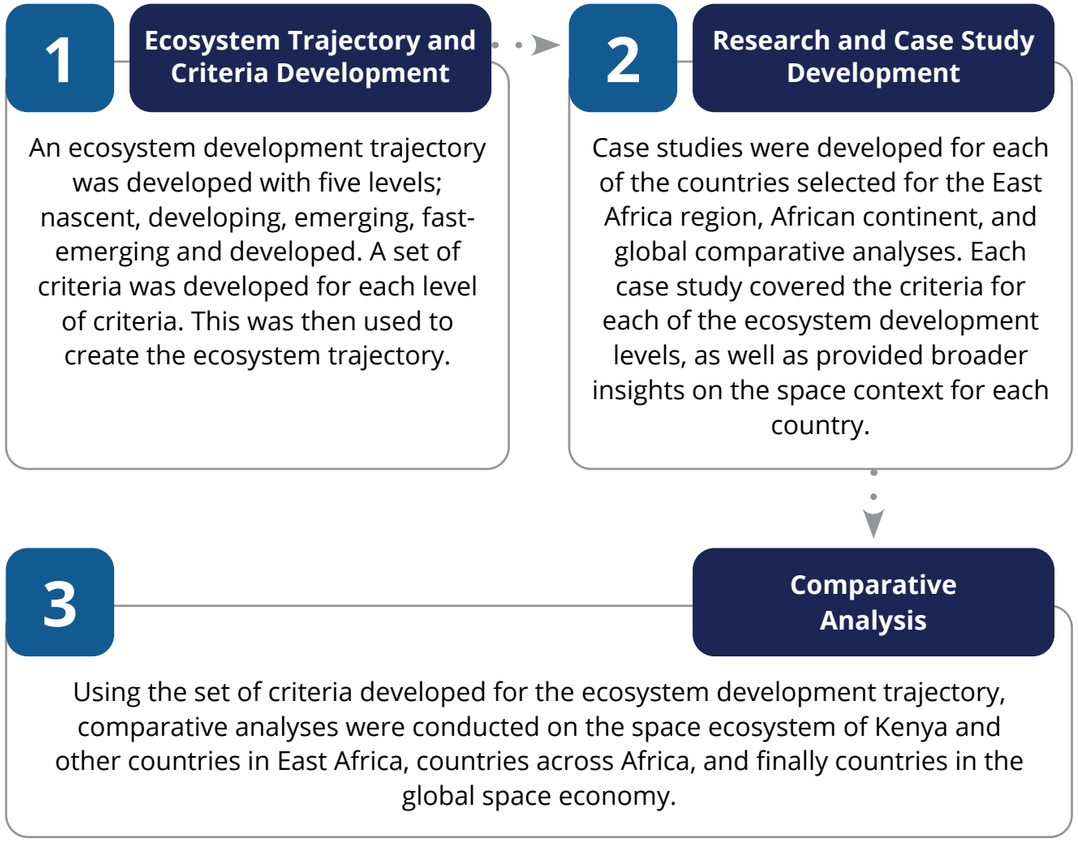


Figure 17: Benchmarking Methodology

7 KENYAN SPACE SECTOR REFERENCES

Adetola, A. (2023). *African Space Industry Annual Report, 2023 Edition.* Retrieved from Space in Africa: https://spaceinafrica.com/2023/08/28/african-space-industry-annual-report-2023-edition/

Aljazeera. (2020). *Kenya's women entrepreneurs lack access to capital, study finds.* Retrieved from Aljazeera: https://www.aljazeera.com/economy/2020/9/30/kenyas-women-entrepreneurs-industry-struggle-to-access-credi.

ASI. (2022). *"LUIGI BROGLIO" SPACE CENTER*. Retrieved from Agenzia Spaziale Italiana: https://www.asi.it/en/the-agency/the-space-centers/luigi-broglio-space-center/

BEA. (2020). *Space Economy*. Retrieved from Bureau of Economic Analysis : www.bea.gov.

Beeline, F. (2018, October 22). *Kenya moves closer to hosting the Square Kilometer Array Pan African telescope*. Retrieved from Funds Beeline: https://www.fundsbeeline.com/News/readNews/XaostCdqrh.html

Blanshe, M. (2024). *The Africa Report.* Retrieved from Geopolitics and self-interest stifle ambitions for economic integration .

DA. (2022). *The Kenyan Startup Ecosystem Report* . Retrieved from Disrupt Africa: https://old.disruptafrica.com/wp-content/uploads/2022/12/The-Kenyan-Startup-Ecosystem-Report-2022.pdf

DA. (2022). *The Kenyan Startup Ecosystem Report 2022.* Retrieved from https://old.disruptafrica.com/wp-content/uploads/2022/12/The-Kenyan-Startup-Ecosystem-Report-2022.pdf

DA. (2023). *The African Tech Startups Funding Report.*

European Union. (2021). *EU Global Action on Space Market Report Africa.* Luxembourg: Publications Office of the European Union, 2021.

Faleti, J. (2021, October 26). *Egypt, Kenya and Uganda Win First UNOOSA/Airbus-Bartolomeo Programme*. Retrieved from Space in Africa: https://spaceinafrica.com/2021/10/26/egypt-kenya-and-uganda-win-first-unoosa-airbus-bartolomeo-programme/

Foust, J. (2022). *Space companies face difficult investment environment.* Retrieved from SpaceNews: https://spacenews.com/space-companies-face-difficult-investment-environment/

Funds Beeline. (2020, 11 02). *KENYA'S SPACE AGENCY TO FUND LOCAL UNIVERSITIES FOR NANOSATELLITE DEVELOPMENT AND SPACE WEATHER STUDY*. Retrieved from Funds Beeline: https://www.fundsbeeline.com/news/readnews/Kenyas-space-agency-to-fund-local-universities-for-Nanosatellite-Development-And-Space-Weather-Study

Giuliani, D., & Malinz, P. (n.d.). *Uganda's unexplored, yet thriving private sector*. Retrieved from Briter Bridges: https://briterbridges.com/ugandas-private-sector

IDIA. (2021). *International Development Innovation Alliance (IDIA)*. Retrieved January 23, 2023, from https://static1.squarespace.com/static/6295f2360cd56b026c257790/t/62a1cd5ed04ab-c2aac8c4880/1654771043557/strengthening+innovation+ecosystems+english.pdf

Iraqi, P. M. (2021). *AFRICAN DEVELOPMENT SATELLITE-An Initiative for Climate Change Detection In*. Retrieved from Egypt Space Agency: https://www.unoosa.org/documents/pdf/copu-os/2021/PM_2_Egypt_African_Development_Satellite-_an_initiative_of_climate_change_Co-pous_2021_1_1_1.pdf

Jong, N. D. (2023). *Inequality Diagnostics Kenya: Mind the Gap - Towards a More Equal Kenya.* Kenya: National Gender and Equality Commission.

Kaberia, J. (2024). *Kenya Leads Digital Revolution, New Report Shows.* Retrieved from CIO Africa: https://cioafrica.co/kenya-leading-digital-revolution-index-report-states/

Kalil, M. (2021). *AFRICAN DEVELOPMENT SATELLITE- An Initiative for Climate Change Detection In Africa Made in Africa by African.* Retrieved from Unoosa.org.

Kenya Space Agency . (2023). *Draft Kenya Space Policy 2023* (1 ed.). Nairobi: KSA.

Kenya Space Agency. (2024). *Possibilities beyond our skies*. Retrieved from Kenya Space Agency: https://ksa.go.ke/

KSA. (2021). *Space Sector Stakeholders Forum.*

KSA. (2022). *Kenya Space Expo Conference 2022 report.*

KTN-UK. (2021). *Place-Based Innovation in Kenya: Regional Innovation Audit Connecting for Positive Change.*

Maurer, A. M. (2023). *Kenya and its role in intra-Africa regional trade The prospects of the EU-Kenya EPA EN BRIEFING.* Retrieved from https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/702596/EXPO_BRI(2023)702596_EN.pdf.

Mose, N. a. (2024). Foreign Direct Investment and Economic Growth in Kenya: A Comprehensive Analysis. *Asian journal of economics, business and accounting*, 1-13.

Nation. (2023, 4 11). *History as Taifa-1 satellite goes live*. Retrieved from Nation.Africa: https://nation.africa/kenya/news/history-as-taifa-1-satellite-goes-live-4194678

Njeri, Z. (2023). *UNOOSA*. Retrieved from OPERATIONAL SPACE WEATHER MONITORING PROGRAMME IN KENYA: https://www.unoosa.org/documents/pdf/psa/activities/2023/GNSS2023/GNSS2023_14_02.pdf

OECD. (2022, July 12). *OECD Handbook on Measuring the Space Economy, 2nd Edition* . Retrieved from OECD Library.org: https://www.oecd-ilibrary.org/science-and-technology/oecd-handbook-on-measuring-the-space-economy-2nd-edition_8bfef437-en

Poteet, L. N. (2021, January 29). *NASA Earth Sciences and Applied Sciences*. Retrieved from https://appliedsciences.nasa.gov/about/our-team/lia-poteet: https://appliedsciences.nasa.gov/our-impact/story/nasa-earth-observations-help-kenya-aid-program-reach-more-farmers

RCMRD. (2023). *Report on Geospatial Practioners Workshop held on 2 June 2023.* Nairobi.

SiA. (2021, January 4). *The Impact Of Earth Observation On Disaster Response In Africa*. Retrieved from Space In Africa: https://spaceinafrica.com/2021/01/04/the-impact-of-earth-observation-on-disaster-response-in-africa/

The East African. (2023, April 4). *Number of jobless Kenyans rises to 2.97 million as inflation soars*. Retrieved from The East African: https://www.theeastafrican.co.ke/tea/business/number-of-jobless-kenyans-rises-to-2-97m-4184722

(2022). *The Kenyan Startup Ecosystem Report* .

TiA. (2018). *How Blockchain Technology helps Small Scale Enterprises in Kenya.* Retrieved from Tech in Africa.

UKGCRF. (2019, February 8). *Phys.org*. Retrieved from Central Africa's first ever research-class astronomical observatory moves a step closer: https://phys.org/news/2019-02-central-africa-research-class-astronomical-observatory.html

UNCTAD. (2023). *World Investment Report 2023.* Retrieved from https://unctad.org/publication/world-investment-report-2023

WEFI. (n.d.). *Women Entrepreneurs Finance Initiative.* Retrieved from https://we-fi.org/

WIPO. (2023). *WIPO Global Innovation Index 2023.* Retrieved from https://www.wipo.int/gii-ranking/en/kenya

World Economic Forum. (2024). ***These 6 countries are using space technology to build their digital capabilities. Here's how.*** Retrieved from: https://www.weforum.org/agenda/2024/04/space-economy-digital-capabilities/

World Economic Forum. (2024***). Space is booming. Here's how to embrace the $1.8 trillion opportunity.*** Retrieved from: https://www.weforum.org/agenda/2024/04/space-economy-technology-invest-rocket-opportunity/

7.1 BENCHMARKING CASE STUDY SOURCES

All case studies

European Union. (2021). ***EU Global Action on Space Market Report Africa.*** Luxembourg: Publications Office of the European Union, 2021.

Kenya

ASI. (2019). ***The Luigi Broglio Malindi Space Center, located in Kenya, is ASI's operational base outside the national territory under the 2004 Decree***. Retrieved from ASI: https://www.asi.it/en/the-agency/the-space-centers/luigi-broglio-space-center/

Kenya Space Agency. (2024). ***Space Clubs***. Retrieved from Kenya Space Agency: https://ksa.go.ke/ksa-space-clubs.html

Uganda

Giuliani, D., & Malinz, P. (n.d.). ***Uganda's unexplored yet thriving private sector***. Retrieved from Briter Bridges: https://briterbridges.com/ugandas-private-sector

Rwanda

Rwanda Space Agency. Giuliani, D., & Malinz, P. (n.d.). ***Uganda's unexplored yet thriving private sector***. Retrieved from Briter Bridges: https://briterbridges.com/ugandas-private-sectorRwanda Space Agency. (2024). ***Rwanda Space Agency Brochure.*** Retrieved from Rwanda Space Agency: https://space.gov.rw/Rwanda_Space_Agency_Brochure.pdf

BrandVoice Partner. (2024). ***Rwanda's Emerging Space Sector And Its Global Contributions.*** Retrieved from Forbes Africa: https://www.forbesafrica.com/brand-voice/2024/04/22/rwandas-emerging-space-sector-and-its-global-contributions/

Kagina, A. (2024). ***Rwanda: The Untapped Potential in Rwanda's Space Economy.*** Retrieved from AllAfrica: https://allafrica.com/stories/202404020006.html#:~:text=RSA%20in%20partnership%20with%20Westerwelle,as%20agriculture%20and%20food%20security%2C

Global Satellite Operators Association. (2022). ***Rwandan Space Agency and the Global Satellite Operators Association to expand cooperation to increase connectivity in Rwanda and the African continent.*** Retrieved from Global Satellite Operators Association: https://gsoasatellite.com/news/rwandan-space-agency-and-the-global-satellite-operators-association-to-expand-cooperation-to-increase-connectivity-in-rwanda-and-the-african-continent/

Sudan

spacewatch Africa. (2019). ***Sudan's First Satellite SRSS-1 Launched by China.*** Retrieved

from: https://spacewatch.global/2019/11/sudans-first-satellite-srss-1-launched-by-china/

SiA. (2019). ***Inside Sudan's National Space Programme.*** Retrieved from Space in Africa***:***

https://spaceinafrica.com/2019/07/23/inside-sudans-national-space-programme/

Cherian, V. (2019). ***Khalid Ehaimer, GM of Sudasat on connecting Sudan***. Retrieved from

https://www.broadcastprome.com/news/satellite/khalid-ehaimer-gm-of-sudasat-on-connecting-sudan/

Ethiopia

SiA. (2019). ***Ethiopian Prime Minister visits CAST to inspect Ethiopia's first satellite ETRSS-1.***

Retrieved from Space in Africa: https://spaceinafrica.com/2019/04/26/ethiopian-prime-minister-visits-cast-to-inspect-ethiopias-first-satellite-etrss-1/

Etssti (2015). ***Entoto Research Centre – ESSTI***. Retrieved from ESSTI:

https://etssti.org/research-center

SiA. (2019). ***Ethiopian Space Science and Technology Institute Director General Sheds Light***

On Ethiopia's Direction in Space Strategy. Retrieved from: https://spaceinafrica.com/2019/08/23/ethiopian-space-science-and-technology-institute-director-general-sheds-light-on-ethiopias-direction-in-space-strategy/ [Accessed 13 Jun. 2024].

SiA. (2024). ***SSGI to Start Generating Revenue from Ground Station Services***. Retrieved from

Space in Africa: https://spaceinafrica.com/2024/02/08/ssgi-to-start-generating-revenue-from-ground-station-services/ [Accessed 13 Jun. 2024]

Nigeria

Space in Africa. (2022). ***Nigeria and Rwanda sign NASA Artemis Accord.*** Retrieved from Space in Africa: https://spaceinafrica.com/2022/12/13/nigeria-and-rwanda-sign-nasa-artemis-accord/#:~:text=The%20official%20Artemis%20Accord%20website,to%20participate%20in%20this%20accord.

National Space Research and Development Agency. (2024). ***Space Licensing.*** Retrieved from National Space Research and Development Agency: https://central.nasrda.gov.ng/?page_id=2602

Space Security Portal. (2023). ***Nigeria.*** Retrieved from Space Security Portal: https://spacesecurityportal.org/states/nigeria

South Africa

South Africa National Space Agency. (2024). ***https://www.sansa.org.za/projects-partnerships/.*** Retrieved from South Africa National Space Agency: https://www.sansa.org.za/projects-partnerships/

Atlas. (2015). ***SOUTH AFRICAN SATELLITES.*** Retrieved from Atlas: http://atlas.sansa.org.za/atlas-sa_satellites.html

The South African Radio Astronomy Observatory. (2024). Retrieved from The South African Radio Astronomy Observatory: https://www.sarao.ac.za/

Iderawumi, M. (2023). ***South African Space Industry Inspires Western Cape's Developing Communities with Former NASA Astronaut***. Retrieved from Space for Africa: https://spaceinafrica.com/2023/05/22/south-african-space-industry-inspires-western-capes-developing-communities-with-former-nasa-astronaut/

Egypt

Faboade, D (2022). ***2022 in Review – Egypt Space Programme. Retrieved from:***

https://spaceinafrica.com/2023/01/04/2022-in-review-egypt-space-programme/

Shay, S. (2018). ***Egypt and the 'space race' The EgyptSat-A project.*** Retrieved from:

https://www.runi.ac.il/media/2zghhg4c/shaulshay-spacerace12-9-18a.pdf.

Makary, M. (2022). ***All You Need to Know About Egypt's Space City.*** Retrieved from:

https://egyptianstreets.com/2022/04/23/all-you-need-to-know-about-egypts-space-city/#google_vignette

Spacehubs Africa. (2020). ***List of satellites and space agencies in North Africa***. Retrieved from: https://spacehubs.africa/north-africa

Adetola, A (2023). ***2023 in Review: Actualising Egypt's Ambition to Lead Space Technology in Africa – Space in Africa***. Retrieved from: https://spaceinafrica.com/2023/12/04/2023-in-review-actualising-egypts-ambition-to-lead-space-technology-in-africa/

SiA. (2020). ***Peek Into Egypt's Growing Capacity in Space and The Approved 10-year National Space Program.*** Retrieved from Space in Africa: https://spaceinafrica.com/2020/03/11/peek-into-egypts-growing-capacity-in-space-proposed-10-year-national-space-program/

Mughal, W. (2024). ***Egyptian Satellite Company (Nilesat) - Egypt's Top 50 Listed Companies 2024***. Retrieved from: https://www.forbesmiddleeast.com/lists/egypts-top-50-listed-companies-2024/raya-egyptian-satellite-company-nilesat-2/

Argentina

European Space Policy Institute. (2021). ***Emerging Spacefaring Nations - Full Report.*** European Space Policy Institute (ESPI).

Turkey

Turklegal. (2020). How to do trademark search in Turkey. Retrieved from Turklegal: https://turklegal.com.tr/en/insights/how-to-make-trademark-search-in-turkey.html

Turkish Space Agency. (2021). National Space Program. Retrieved from Turkish Space Agency: https://tua.gov.tr/en

Slovakia

SSPO. (2023). ***Space Industry in Slovakia.*** Retrieved from Slovak Space Office: https://www.sario.sk/sites/default/files/sario-space-industry-in-slovakia-2024-01-30.pdf

Liptáková, J. (2017). ***First Slovak satellite is orbiting Earth and working well.*** Retrieved from***: https://spectator.sme.sk/c/20577020/first-slovak-satellite-is-orbiting-earth-and-working well.html***

SAS. (2024). ***Slovak Academy of Sciences***. Retrieved from: https://www.sav.sk/?