SPACE TECHNOLOGIES FOR AFRICA's SOCIO-ECONOMIC DEVELOPMENT: LEGAL CONSIDERATIONS

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Table of Contents

ABSTRACT

Africa is blessed with vast natural and human resources. However, Africa's socio-economic development remains limited due to various lingering challenges such as agriculture: food scarcity and food security, disaster management, climate change, and insecurity.

In addressing these lingering challenges, space programs and space technologies could be excellent tools to enhance Africa's socio-economic development. Thus, this research examines legal considerations for African states to harness space technologies in propelling Africa's socio-economic development, focusing on the domestic legal framework for implementing international programs and commitments in these selected African States - *Nigeria, South Africa, and Ethiopia.*

This research is divided into two aspects – Technical and Legal. The technical aspect lays the background for this research, evaluates how space technologies can solve Africa's socio-economic development challenges, and assesses international programs supporting Africa in leveraging space technologies for Africa's benefit. The assessment of these international programs aims to identify if these programs have indeed helped Africa. If yes, how can they be expanded, and if not, what should be done?

The second part of this research examines legal considerations - *laws and policies*. This section analyzes the domestic space laws and policies of the selected African States in supporting space programs in their region, propelling private space participation, and implementing their international space obligations.

Also, this research compares the domestic space framework in India and Indonesia with that of the African States assessed in this work and further analyzes the space policies of the United States of America and Canada to determine any lesson(s) for Africa.

In addition to the legal considerations assessed, this research examines the intersection of law and economics in advancing Africa's space sector. Particularly evaluating the role of leaders like the African Union and the African Development Bank in enhancing economic investments in the African space industry.

Finally, this research examines the role of law in enhancing Africa's launch capacities, including legal considerations for incentivizing the sale and purchase of satellite data in Africa.

RÉSUMÉ

L'Afrique est une terre bénie par des ressources naturelles et humaines. Cependant, le développement socio-économique du continent africain est limité par des défis constants tels que l'agriculture: pénurie alimentaire et sécurité alimentaire, la gestion des catastrophes naturelles, le changement climatique et l'insécurité.

Afin de contrecarrer les effets de ces défis, le recours aux programmes spatiaux ainsi qu'aux technologies de l'espace s'avère être un excellent moyen contribuant au développement socio-économique de l'Afrique. De ce fait, cette recherche examine les mécanismes juridiques à disposition des États Africains permettant de mettre la technologie spatiale au service du développement socio-économique du continent, en se focalisant notamment sur le cadre juridique national d'implantation des programmes et des engagements internationaux dans les pays africains suivants ; le Nigeria, l'Afrique du Sud et l'Éthiopie.

Cette recherche se divise en deux parties avec d'une part l'étude de l'aspect technique et d'autre part l'analyse de l'aspect juridique.

La partie technique permet de dresser le contexte de cette recherche, d'étudier l'impact des technologies spatiales dans la résolution des défis socio-économiques de l'Afrique et d'évaluer les programmes internationaux soutenant l'Afrique en tirant parti de la technologie spatiale au profit du continent africain. L'évaluation de ces programmes internationaux a pour but de vérifier si ces derniers ont en effet contribué à l'Afrique. Si oui, comment peuvent-ils être étendus ? Si non, qu'est ce qui doit être fait ?

La deuxième partie de la recherche examine les considérations juridiques comme les lois et les politiques adoptées. Cette section analyse les lois et politiques nationales des pays africains susmentionnés qui favorisent les programmes spatiaux de la région, encouragent la participation des acteurs privés et implantent les obligations internationales dans le secteur spatial.

Cette recherche compare également les cadres juridiques des pays comme l'Inde, l'Indonésie avec ceux des pays africains mentionnés en amont et analyse de manière plus approfondie les politiques spatiales adoptées par les États-Unis et le Canada afin de déterminer si des leçons peuvent être tirées pour l'Afrique.

Au delà des réflexions juridiques mentionnées, cette recherche examine également le croisement du droit et de l'économie dans le développement de l'industrie spatial africain, en évaluant notamment le rôle des institutions comme l'Union africaine et la Banque Africaine de Développement dans le renforcement des investissements au sein du secteur spatial africain.

Enfin, cette recherche analyse le rôle du droit dans l'amélioration des capacités de lancement de l'Afrique, en incluant également des considérations juridiques afin d'inciter la vente et l'achat de données satellitaires en Afrique.

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CHAPTER I

Opening Question

How can space technologies propel Africa's socio-economic development? The role of law in addressing this question sets the path for this research.

1.0.Introduction

Africa is bestowed with tremendous natural and human resources that it continually explores in meeting its socio-economic development needs. However, the continent's socio-economic development is plunged by various challenges ranging from agriculture and food security, disaster management, and climate change to insecurity. There is a pressing need to address these challenges in driving Africa's socio-economic development, for the achievement of which space programs can be excellent tools.

This research will cover national legal and regulatory mechanisms with emphasis on implementing international space programs and commitments in Nigeria, South Africa, and Ethiopia.

This research aims to fill the legal, policy, and implementation framework gaps for space exploration in Africa, driving home the importance of space technologies to Africa's socio-economic development. This research, therefore, aims to answer the following questions;

1. What is the role of law in building the capacity of African states to exploit space technologies for Africa's socio-economic development?
2. What legal and policy framework needs to be implemented to properly harness space technologies to solve Africa's socio-economic development challenges?

Chapter one will establish the rationale for this research by examining the role of space technologies in solving issues of food security, disaster management, climate change, and insecurity in Africa. The role of space technologies in solving these identified socio-economic development challenges are examined below;

1.1. Space Technologies for Africa's Socio-Economic Development

1.1.1. *Space Technologies for Agriculture and Food Security*

Food security is essential to every nation for the sustenance of its citizens, and agriculture is at the core of the food supply chain for attaining food security. Agriculture plays a crucial role in supporting the livelihood of humans and livestock, and the growth of the agricultural sector is essential for economic development and poverty alleviation.[1]

Africa faces unique challenges concerning agriculture and food security in areas like drought, desertification, biodiversity, and the growing population in Africa battles the threat of access to adequate food supply. Space technologies, however, play a vital role in addressing the threat to food security in Africa.

Space technologies are valuable to farmers, agronomists, food manufacturers, and policymakers in agricultural development, desirous of enhancing production and profitability.[2] Satellite farming is one of the methods explored to achieve food security, using space tools like earth observation satellites. Satellite farming "operates based on the principle of observing, computing, and responding to inter and intra-field crops variability."[3] Remote sensing provides data relevant for monitoring rainfall, drought, soil, and crop development, thereby providing information helpful to farmers in guiding their planting and harvesting plans.

The availability of water also plays a fundamental role in food security, and space tools provide the opportunity to monitor water resources which is essential for agricultural yield/productivity.

Satellites help farmers and policymakers make informed agriculture decisions by monitoring changes in the volume and flow of water in Earth's atmosphere, land surfaces, and underground aquifers. It is crucial to observe water resources from space to better understand and forecast agricultural yield and food security worldwide.[4] Remote sensing satellites are useful space tools for monitoring terrestrial water storage. Irregularities in terrestrial water storage, including deep soil humidity and groundwater, can be calculated using precise, satellite-based measurements of changes in Earth's mass over space and time, providing guidance in

[1] L. Karthikeyan, et. al., "A Review of Remote Sensing Applications in Agriculture and Food Security: Crop Growth and Yield, Irrigation, and Crop Losses" (2020) 586:124905 J Hydrol at 2.

[2] "Benefits of Space: Agriculture" (2021), online: *United Nations Office for Outer Space Affairs* <www.unoosa.org/oosa/en/benefits-of-space/agriculture.html>

[3] MB Dastagiri & Naga Sindhuja PV., "Satellite Farming in Global Agriculture: New Tech Revolution for Food Security and Planet Safety for Future Generation" (2020) 4:4 ASAG J at 2.

[4] "Food Security from Space: Monitoring Indicators of Water Availability for Agriculture" (2019), online (pdf): *National Aeronautics and Space Administration* <www.science.gsfc.nasa.gov/610/applied-sciences/images/WaterAvailability_8-5-2019.pdf>

monitoring droughts and the effects of irrigated agriculture on groundwater supplies.[5] The Northern part of Nigeria, for example, relies heavily on irrigation in boosting their agricultural production because the land in the North is dry, and they experience a short period of rainfall insufficient to sustain the growth of the plants. This difficulty influences their irrigation practice which is vital in boosting agricultural production in a region that supplies most of the food and vegetables consumed by the Nigerian populace. Irrigation however, has potential impacts on the environment.

Remote sensing can provide land parameter information on a large scale, offering a valid method for determining the impact of irrigation on land surface parameters and the local surface climate.[6] The government can leverage remote sensing to protect the impact of irrigation on the climate in promoting a sustainable environment for both the present and future generations.

Soil moisture is also important to farmers in preparation for planting season and crop yield optimization. Satellites are vital space tools for monitoring soil moisture, as changes in soil moisture owing to water-related stress can impede the growth of plants and reduce crop production. Passive microwave satellites offer a reliable estimate of surface soil moisture.[7]

In conducting extensive research and demonstrating the importance of space to agriculture, the Food and Agriculture Organization of the United Nations (FAO) and the International Atomic Energy Agency (IAEA) Division of the Nuclear Techniques in Food and Agriculture undertook a joint project on space breeding.[8] In achieving this space breeding project by FAO/IAEA, a Chinese spacecraft conveyed approximately 10kg of Pokkali rice to space to observe heritable alterations in the genetic blueprint of the Pokkali rice seed and planting materials induced by the effects of cosmic rays, microgravity, and magnetic fields in space. After some time in space, these seeds were returned to Earth and planted in the FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf, Austria, to assess offspring for suitable traits like resistance to stress and enhanced quality.[9] The FAO also uses data gathered from remote sensing as a critical element for the efficient monitoring of agricultural production through the

[5] Ibid.

[6] Shulin Liang & Jindi Wang, *Advanced Remote Sensing: Terrestrial Information Extraction and Applications* (Boston: Elsevier/Academic Press, 2020) at 899.

[7] *Supra*, note 4.

[8] Space breeding involves the use of space environment to discover hidden potentials in crops.

[9] "Space for Agriculture Development and Food Security: Use of Space Technology within the United Nations System" (2016) at 5, online (pdf): *United Nations Office for Outer Space Affairs* <www.unoosa.org/res/oosadoc/data/documents/2016/stspace/stspace69_0_html/st_space_69E.pdf>

global agroecological zones data portal and the FAO's integrated land resources data management system.[10]

Remote sensing also plays a vital role in monitoring the transition of cropland. The information on changes to cropland and the drivers of such changes are essential in assessing food and water security and guiding sustainability policies.[11]

Space tools provide farmers and policymakers with real-time data helpful in preparing for planting seasons and strategically optimizing crop yield with the sustainability of the environment in the mind of all stakeholders. Therefore, the government and policymakers need to drive space technologies to promote agriculture and food security in Africa to improve agriculture towards attaining food security.

1.1.2. *Space Technologies for the Environment (Flooding & Climate Change)*

"Climate change threatens to have a catastrophic impact on ecosystems and the future prosperity, security, and well-being of all humankind."[12] The need to promote sustainable practices that preserve our environment cannot be over-emphasized. Earth observation satellites are useful space tools for monitoring climate change and the effects of climate change by providing environmental data for climate experts to comprehend and assess the impacts of climate change. The data from earth observation satellites on climate change is also crucial for governments and policymakers in advancing policies that better protect the environment and reduce climate change.

Satellites monitor changes in polar sea ice, greenhouse gas emissions, temperature changes, rise in sea level, and other parameters.[13] Climate change is an alteration in long-term weather patterns predominantly caused by greenhouse gases, making the earth warmer by trapping energy in the atmosphere. Global emissions of greenhouse gases could grow further by 37% by 2030.[14] The effect of climate change threatens agriculture and food security, nature, and continuous human existence. Meteorological, telecommunication, earth observation satellites

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[10] *Report of the Secretary-General: Exploring Space Technologies for Sustainable Development and the Benefits of International Research Collaboration in this Context*, ECOSOC, 23rd Sess, E/CN.16/2020/3 (2020) at 3.

[11] Shulin, *Supra*, note 6 at 874.

[12] Statement by Bank Ki-moon (former Secretary-General of the United Nations). "Space and Climate Change: Use of Space-Based Technologies in the United Nations System" (2011), online: *World Meteorological Organization WMO-No. 1081* <www.library.wmo.int/doc_num.php?explnum_id=7750>

[13] "Space and Climate Change: Use of Space-Based Technologies in the United Nations System" (2011), online: *World Meteorological Organization WMO-No. 1081* <www.library.wmo.int/doc_num.php?explnum_id=7750>

[14] "Space Technologies and Climate Change" (2014), online (pdf): *OECD Space Forum, Directorate for Science, Technology, and Innovation* <www.oecd.org/futures/space-technologies-and-climate-change.pdf>

provide essential data and information that helps monitor climate change and its effects on wildlife, humankind, agriculture, and food security.

Meteorological satellites, for example, provide data for weather predictions. "Climatologists and glaciologists rely on continuous satellite observations of the Arctic and Antarctic to study, in almost real-time, climate change processes."[15] Satellite data are also used to monitor the quality of water bodies and detect natural and artificial contaminants like oil spills.[16] This is particularly important for African states with polluted water bodies. For example, water bodies in the Niger Delta region of Nigeria are largely polluted by oil spillage. The Niger Delta is the home of oil in Nigeria. This good natural resource of this region has occasioned much harm to its residents as their waters are polluted. The pollution of water bodies in the Niger Delta, has also resulted in the loss of marine livestock whose lives are threatened by the oil spillage, resulting in loss of livelihood to farmers whose farming business is predominantly fishing.

Oil exploration in the Niger Delta has occasioned adverse environmental impacts in the region through continuous ecological, economic, and physical disasters that accumulated over the years owing to inadequate scrutiny and lack of assessment.[17] One of the evident effects of oil spillage and production activities in the Niger Delta has been the loss of mangrove trees, formerly a source of fuel-wood for the local community and habitat for biodiversity in Niger Delta. However, due to the effects of oil spillage, the mangrove trees can no longer withstand the excessive toxicity levels of petrochemicals, destroying the habitat.[18]

In addition to Nigeria's space agency (NASDRA)'s collaboration with universities on how to revive the mangrove in the Niger Delta[19], there is a pressing need for the government and relevant stakeholders to clean up the Niger Delta to preserve the water bodies in this area and other affected areas. Satellite data provides real-time data that the government and stakeholders can leverage in determining natural and artificial contaminants of water bodies in solving issues of water pollution. As a forward-thinking approach, the government can promulgate policies addressing the quality of water bodies, whereby the space agency leverages satellite data to identify the pollutants of water bodies and tackle the same. The government can also execute

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[15] Ibid.

[16] Shulin, *Supra*, note 6.

[17] Yaw A. Twumasi & Edmund C. Merem "GIS and Remote Sensing Applications in the Assessment of Change Within a Coastal Environment in the Niger Delta Region of Nigeria" (2006) 3:1 Int J Environ Res Public Health at 99.

[18] Ibid.

[19] "Nigeria Satellites Playing Strategic Roles in War Against Insurgents" (3 August 2014), online: *TheNews Nigeria* <www.thenewsnigeria.com.ng/2014/08/03/nigeria-satellites-playing-strategic-roles-in-war-against-insurgent/>

agreements with large oil corporations doing business in the Niger Delta region on strategies to prevent oil spillage in the course of their business, including partnerships with the space agency on using space technologies to address the issue of oil spillage in the region.

In East Africa, Tanzania monitors deforestation and grassland degradation in the Greater Mahale ecosystem and Lake Tanganyika basin through the Nature Conservancy (TNC). This body uses satellite imagery to identify the drivers of forest loss and afterward consults the communities on progressive forest management plans.[20]

Kenya, on the other hand, derives economic benefits from its nature-based tourism. However, Kenya's wildlife faces the threat of habitat loss and degradation, and poaching dangers because Kenya's growing population now competes for the same terrestrial land and resources. In addressing this pressing issue, the World Wide Fund for Nature commenced a project that attaches GPS satellite tracking devices on elephants in Kenya to understand the elephants' behaviors and prevent poaching. The GPS satellite tracking device provides valuable data and information to help decision-makers select areas for land reserves, preserve biodiversity, and safeguard the elephants' habitat[21] in preserving Kenya's nature-based and wildlife tourism.

Outside Africa, German satellite manufacturer OHB developed the Environmental Mapping and Analysis Program called EnMap, managed by the German Aerospace Center. "EnMap is a German hyperspectral mission that aims at monitoring and characterizing Earth's environment on a global scale."[22] EnMap aims to provide specific data to tackle critical environmental challenges connected to human endeavor and climate change by examining and decoding connected environmental processes to support and foster the sustainable management of Earth's resources.[23] This mission by Germany is a laudable one that advances space technologies to solve a significant environmental problem of concern to every nation.

EnMap creators aim to provide consistent data to help farmers avoid crop failures by predicting nutrient deficit, pest infestations, and water scarcities. The EnMap satellites have the potential to monitor deforestation and the structure of forests, detect early signs of drought, map tree species, monitor the erosion of fragile coastlines, and pollution in water bodies.[24] It is no doubt

[20] Sara Jerving "Space Tech is Helping Conservation Efforts Better Inform Development in Africa" (5 June 2020), online: *devex* <www.devex.com/news/space-tech-is-helping-conservation-efforts-better-inform-development-in-africa-97328>

[21] Ibid.

[22] "Welcome to EnMap: The German Spaceborne Imaging Spectrometer Mission" (2021), online: *EnMap Hyperspectral Imager* <www.enmap.org>

[23] "Mission" (2021), online: *EnMap Hyperspectral Imager* <www.enmap.org/mission>

[24] Olivera Zivkovic "A New Generation of 'Hyper' Satellites to Prevent A Climate Catastrophe" (2019), online: *DW Science* <www.dw.com/en/a-new-generation-of-hyper-satellites-to-prevent-a-climate-catastrophe/a-51535184>

that a mission like this is very capital intensive and requires technical experience and expertise, which is currently lacking in Africa. However, Africa can benefit from the EnMap mission by negotiating and entering into a partnership with the German Aerospace Center. Through the Agreement, Africa can use provided data from the EnMap satellite to solve some of the socio-economic development challenges while working on building indigenous capacity to carry out missions of this nature later in the future.

In the United States, NASA's satellite data and ground measurements support research into continuing variations to water distribution. For example, the U.S. National Climate Assessment leverages NASA satellite data and ground measurements in examining climate change and the impacts of climate change in each region of the United States.[25] In Europe, the European Remote Sensing Satellite (ERS) Mission provided valuable information and data for tracking changes in sea level, sea state, sea surface temperature, sea ice thickness, the elevation and velocity of ice sheets, land surface temperature, soil moisture, cloud, aerosol and more.[26]

Data from satellites belonging to African states in space will be helpful for research purposes and for influencing policies that advance the use of satellite data to address the pressing socio-economic development issues in Africa.

Also, at the heart of future satellite launches in Africa, the launching states need to have concrete plans on how the data from their satellites in space can be used for research and other purposes to solve some of these socio-economic development challenges. While it is important to celebrate the launch of satellites as milestones for each State, Africa will better benefit from making strategic plans to leverage data from the launched satellites to preserve the Earth's resources, protect the environment and improve the quality of life of its citizens.

1.1.3. *Space Technologies for Disaster Management & Security*

In addition to the artificial and natural disasters on Earth, the effects of climate change on the environment are a catalyst for various disasters like droughts, earthquakes, floods, volcanic eruptions, wildfire, landslides, cyclones, tsunamis, heat wave, hurricanes and tropical storms. This makes it imperative for every State to devise adequate measures to prevent disasters and mitigate the effects of a disaster.

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[25] Ellen Gray & Jessica Merzdorf "Earth's Freshwater Future: Extremes of Flood and Drought" (2019), online: *NASA Global Climate Change: Vital Signs of the Planet* <www.climate.nasa.gov/news/2881/earths-freshwater-future-extremes-of-flood-and-drought/>

[26] "ESA Missions for Climate Change: Major ESA Satellite Missions for Monitoring Climate Change from Space" (2021), online: *The European Space Agency: ESA Climate Office* <www.climate.esa.int/en/evidence/esa-missions-relating-climate>

"Disaster management is a very complex, difficult, and dangerous activity. It is an arena where lives and property are at risk and decisions have tremendous consequences. Our access to space and the many capabilities that our access to space provides us are an important part of the evolving toolkit now utilized by disaster managers".[27]

There have been several attempts to distinguish between natural and artificial disasters, which have proven difficult over the years due to the overlap in events that can transition a natural disaster into an artificial disaster and vice-versa.

For example, a natural disaster can be caused or heightened by human activity. An illustration of such is desertification caused by excessive land use and deforestation. Also, disasters like floods or mudflows originating from artificial hydrological instability are another example.[28]

The case-law of the European Court of Human Rights and international instruments regulating disaster prevention and response essentially deems a disaster as natural, provided the event causing the disaster is natural even if, in its turn, the event may result from human triggers.[29] Hence, the trigger factor of a disaster does not change the nature/classification of the disaster once the causal factor or event of the disaster is natural.

Space technologies are essential elements for local, regional, and national disaster risk reduction strategies.[30] Space technologies like remote sensing and satellite telecommunications are great space tools that provide States with technical support and real-time data for disaster prevention and mitigation efforts. Satellites provide vital extreme weather warnings, telecommunications, mapping, positioning, navigation, and helpful imagery[31] to identify disaster-prone areas in preparation for a disaster and to mitigate and respond to outbreaks. Earth observation satellites and high-technology in situ instruments also aid in detecting and monitoring disaster risks, especially natural hazards, and exposure to vulnerability.[32]

"Remote sensing is carried out with various types of sensors mounted on various platforms, ranging from aircraft to satellites."[33] Satellites provide in-situ monitoring and telemetry

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[27] Scott Madry, *Space Systems for Disaster Warning, Response, and Recovery* (New York: Springer, 2015) at 2 (eBook).

[28] Diego Zannoni, *Disaster Management and International Space Law,* vol. 15 (Leiden: Brill Nijhoff, 2019) at 29 (eBook).

[29] Ibid.

[30] *Supra*, note 9.

[31] Scott, *supra* note 27.

[32] *Supra*, note 9.

[33] UNCRD Proceedings Series No. 28, "Space Technology Applications for Natural Disaster Mitigation" (March 1998) online (pdf): *United Nations Centre for Regional Development* <www.uncrd.or.jp/content/documents/196Space%20Technology%20Applications%20for%20Natural%20Disaster%20Mitigation.pdf>

systems for data like ocean buoy and flood monitoring stations. Precision Positioning, Navigation, and Timing (PNT) satellites can provide quick positioning and navigation data for responders who can use the data from the PNT satellites to map damage in the field.[34]

The Vienna Declaration on Space and Human Development[35] highlighted the need to protect the Earth's environment and resources by implementing an integrated, global system, to manage natural disaster mitigation, relief, and prevention efforts, through earth observation, communications, and other space-based services.[36]

This provision reiterates the importance of space technologies in protecting the earth's environment and managing scarce resources, particularly regarding the prevention and mitigation of disasters on the surface of the Earth. Remote sensing provides government and stakeholders with valuable information on the land's topography, providing data for the early detection of potential land disasters and serving as a fundamental tool for mapping out affected areas during a disaster in understanding and analyzing the cause of the disaster.

Globally, space tools have been exploited in addressing disasters at different times. For example, satellite technologies provided valuable communication capabilities during the unfortunate outbreak of hurricanes Katrina and Rita in 2005.[37] In the wake of the unfortunate Beirut explosion of 4 August 2020 that left at least 135 people dead and about 300,000 people homeless, satellite imagery acquired following the explosion uncovered a large crater where the warehouse had been, revealing damage to the port area.[38] The Beirut incident is one of the instances where the 'International Charter Space and Major Disasters' has been activated. "The Charter is a worldwide collaboration, through which satellite data are made available for the benefit of disaster management."[39] By combining earth observation assets from various space agencies, the Charter makes room for the coordination of resources and expertise for rapid response to major disasters, thereby assisting civil protection authorities and the international humanitarian community in tackling disasters.[40]

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[34] Scott, *supra* note 27 at 47.

[35] The Space Millennium: Vienna Declaration on Space and Human Development was adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space.

[36] Resolution 1 par. 1(b)(ii) The Space Millennium: Vienna Declaration on Space and Human Development (1999), online (pdf): *United Nations Office of Outer Space Affairs* <www.unoosa.org/pdf/reports/unispace/viennadecIE.pdf>

[37] Scott, *supra* note 27 at 62.

[38] "Industrial Accident in Lebanon" (5 August 2020), online: *International Charter Space & Major Disasters* <www.disasterscharter.org/web/guest/activations/-/article/industrial-accident-in-lebanon-activation-664->

[39] "About the Charter", online: *International Charter Space & Major Disasters* <www.disasterscharters.org/web/guest/about-the-charter>

[40] Ibid.

The International Charter Space & Major Disasters is a great initiative that leverages space technologies in providing valuable support for disaster management to States that are authorized users of the Charter, faced with disasters at any time of the day.

The International Space Station (ISS) has also supported varied space research and projects that have birthed ingenious technologies solving some of humankind's problems. For example, with crew handheld camera imagery as a core component, the International Space Station is now an active participant in orbital data collection to support disaster response within the United States and abroad.[41]

The United Nations General Assembly Resolution 61/110[42] established the United Nations Platform for Space-based Information for Disaster Management and Emergency Response known as UN-SPIDER. UN-SPIDER's mission is to "ensure that all countries and international and regional organizations have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle."[43] The UN-SPIDER is also established to facilitate capacity-building and institutional strengthening, particularly for developing countries.[44]

The European Space Agency Discovery and Preparation initiative has supported studies that explore the prediction of natural disasters using satellite data. The ESA Discovery and Preparation, for example, supported studies that examined the use of satellite data for analyzing drought in Southern Africa.[45]

The Sendai Framework for Disaster Risk Reduction 2015-2030 recognizes the importance of international cooperation and global partnership in assisting disaster-prone developing countries, least developed countries, small island developing States, landlocked developing countries, and African countries. The Sendai framework notes the requirement for "urgent strengthening of international cooperation and ensuring genuine and durable partnerships at

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[41] Michael Johnson "20 Breakthroughs from 20 Years of Science Abroad the International Space Station" (28 October 2020), online: *NASA Space Station Research* <www.nasa.gov/mission_pages/station/research/news/iss-20-years-20-breakthroughs>

[42] *United Nations Platform for Space-based Information for Disaster Management and Emergency Response*, A/RES/61/110, UNGA, 61st Sess, (2007).

[43] "What is UN-SPIDER?" online: *United Nations Office for Outer Space Affairs: UN-SPIDER Knowledge Portal* <www.un-spider.org/about/what-is-un-spider>

[44] Ibid.

[45] "Space Technology for Life on Earth" (13 April 2021), online: *The European Space Agency* <www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Space_technology_for_life_on_Earth>

the regional and international levels in order to support developing countries to implement the present Framework, in accordance with their national priorities and needs."[46]

The Sendai framework and other international programs aimed at supporting Africa in addressing the socio-economic development challenges identified in this chapter will be assessed in chapter two of this work in determining the success and limitations of these programs in helping Africa. The subsequent chapters of this research will also examine Africa's undertakings in overcoming these challenges and the way forward for Africa to take center stage in exploiting space tools to overcome the identified socio-economic development challenges through the instrument of the law.

Earth observation satellites are also valuable space tools for security and defense purposes. Insecurity is a critical issue that has plagued the Northern region of Nigeria for some years, up until date. In one of the prominent kidnaps in the history of Nigeria, about 276 girls of the Government Girls College in Chibok, Northern Nigeria, were abducted by the Boko Haram insurgent group. While some of the students were daring enough to escape captivity, another set of students were released following negotiations between the Federal Government of Nigeria and the Boko Haram group. However, it is unfortunate that some of the students are still in captivity, several years after their abduction. The Nigerian Space Agency (NASDRA) stated that they have the satellite image of Sambisa forest where the girls were held in captivity and have made the same available to the security agencies, and it now behooves the security agencies to read it and interpret it.[47] This highlights how Nigeria has not fully maximized space tools to solve the problem of insecurity in Nigeria (which lingers to date), including partnering with security agencies to accurately read and interpret satellite data in making the most of the data to address the issue of insecurity in Nigeria.

In assessing how Africa is looking into Space, the World Economic Forum inaccurately reported that "in 2014, Nigeria used its SatX and Sat2 to monitor the group's (*Boko Haram*) movements *and to help find the 273 girls it abducted*"[48] (emphasis added). This highlights one of the limitations of this research on discrepancies and inaccuracy of data available on the subject.

As stated above, some of the girls daringly escaped captivity independently. Some were released following negotiations between the Federal Government and Boko Haram, while the

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[46] "Sendai Framework for Disaster Risk Reduction 2015 - 2030", online(pdf): *United Nations Office for Disaster Risk Reduction* <www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>

[47] *Supra*, note 19.

[48] Scott Firsing "How Africa is Looking Into Space" (18 May 2015), online: *World Economic Forum* <www.weforum.org/agenda/2015/05/how-africa-is-looking-into-space/>

BringBackOurGirls campaign group remains unrelenting in advocating for the rescue of the remaining girls in captivity.

1.2. Benefits of Space Technologies to Africa's Socio-Economic Development

Space technologies provide various benefits to Africa's socio-economic development. As examined above, different space technologies like remote sensing, earth observation satellites, telecommunications, and Geographic Information Systems (GIS), are exploited to solve various socio-economic development challenges highlighted in this work.

Space technologies play an important role in advancing economic growth, influencing government and industry decisions and policies towards promoting space technologies for socio-economic development. Harnessing space technologies for Africa's socio-economic development also plays a vital role in boosting trade and economic investments in Africa. On the economic implication of space technologies in Africa, chapter four of this research will consider the role of law in enhancing Africa's launch capacities and regulations/policies incentivizing the sale and purchase of satellite data in Africa to boost investments.

In the article Socioeconomic Benefits of Space Technology for Africa, Yeshurun noted that "Africa cannot boast of possessing the technical know-how to participate independently in space-related activities as a service provider, but only as a consumer of space-derived products."[49] While this is mainly accurate, some African states have provided helpful space services beyond solely consuming space-derived products. For example, following Hurricane Katrina in the United States, Nigeria's satellite, NigeriaSat-1, was the first satellite to send back pictures of the United States' east coast. The orbiter also contributed images to aid workers following the Indian Ocean tsunami in 2004.[50]

NigeriaSat-1 is one of the Disaster Monitoring Constellation (DMC) satellites built to address the need for regular reassessment and international coverage to monitor natural disasters, providing satellite imagery or disaster management at no cost.[51] Also, the Nigerian Space Research Development Agency (NASDRA) is a member of the International Charter Space & Major Disasters, working with other space agencies and operators to provide satellite imagery

[49] Yeshurun Alemayehu Adde (Kibret), "Socioeconomic Benefits of Space Technology for Africa" (2019) 10:6 IEE-SEM J at 260.

[50] Jacob Aron "How Nigeria Has Been Using Its Satellites" (9 August 2013), online: *NewScientist* <www.newscientist.com/article/dn24025-how-nigeria-has-been-using-its-satellites/>

[51] Dr. Ganiy I. Agbaje "Current Trends in Nigeria's Space Development Programme to Facilitate Geospatial Information (GI) Sharing and Implementation of the NGDI" (2008), online(pdf): *U.S. Department of State* <www.2001-2009.state.gov/documents/organization/110820.pdf>

for disaster monitoring and management. Through the International Charter in 2007, NigeriaSat-1 satellite data was used to respond to floods in Argentina, Uruguay, North Korea, Pakistan, China, Vietnam; Nevado del Ruiz volcano in Columbia; oil spill in Lyme-Bay, United Kingdom, wildfires in California; locust threat in Algeria, Syria, amongst others.[52] These are instances where an African State has been more than a consumer of space-related products. However, this does not undermine the fact that African States are not maximizing the benefits of space technologies in addressing the socio-economic development challenges in the continent. Also, Africa currently lacks the technical capacity to fully exploit space technologies to address Africa's socio-economic development problems. Notably, there is a growing need to fill the space technology gap in Africa by promoting the education and training of the younger generation in Africa. This speaks to the need and importance of space technology as a core part of the education curriculum in schools across Africa. The benefits of space technologies to Africa's socio-economic development far outweigh the cost Africa needs to expend in training and building indigenous space technology capacity.

1.3. Synopsis of the Chapters

Chapter One establishes the rationale and background for this research. This chapter identifies the significant socio-economic development challenges in Africa and the role of space technologies in solving these challenges, including the benefits of space technologies to Africa's development.

Chapter Two assesses international programs, including public and private initiatives supporting Africa in utilizing space tools to solve its socio-economic development challenges. This assessment aims to ascertain the success and limitations of these programs and the role of African States in leveraging these international programs to develop indigenous capacity and national space programs for Africa's benefit.

Chapter Three analyzes the legal and governance framework for space development in Africa. This chapter assesses Nigeria, South Africa, and Ethiopia's national space laws and policies in identifying potential gaps in the laws and any hindrance to its implementation, including its provisions for stimulating private sector participation and mechanisms for implementing their international space obligations.

[52] Ibid.

This chapter further analyzes the space law and policy implementation framework in the United States and Canada; and undertakes a comparative analysis of the legal framework for space activities in India and Indonesia to identify any lessons for Africa.

Chapter Four examines the intersection of law and economics for Africa's space development. Particularly, this chapter assesses the role of key leaders like the African Development Bank and the African Union in Africa's space development.
This chapter further examines the role of law in enhancing Africa's launch capacities, including laws and policies for launch collaborations to build indigenous capacity through the concept of UBUNTU and its application to driving strategic space partnerships in Africa.
This chapter also assesses the legal framework for incentivizing satellite data commercialization in Africa.

Chapter Five is the concluding chapter of this research, focusing on Africa's role in its space sector development, legal and policy recommendations for maximizing the benefits of space technologies for Africa's socio-economic development.
This chapter also contains recommendations for enhancing Africa's space legal framework by highlighting the identified legal issues in the space laws and policies of Nigeria, South Africa, and Ethiopia and recommendations for addressing the identified legal issues.

CHAPTER II

ASSESSMENT OF INTERNATIONAL PROGRAMS SUPPORTING AFRICA's USE OF SPACE TECHNOLOGIES TO ADDRESS IT'S SOCIO-ECONOMIC DEVELOPMENT CHALLENGES

2.0. Introduction

Partners and sponsors play a crucial role in supporting every region, nation, and Continent in achieving its socio-economic development goals. Like every other Continent, Africa benefits from partners and sponsors in the international community who, through various initiatives and programs, have helped and continue to support Africa in leveraging space technologies and the benefits of space exploration for Africa's socio-economic development.

Various international, public, and private initiatives aim to support Africa in leveraging space technologies to address Africa's socio-economic development challenges. It is crucial to assess these various international programs to understand if they have helped Africa. If these programs have helped Africa, it will be essential to examine how they can be expanded. If these programs have faced limitations with their objective to help Africa, what are the reasons for these limitations? Importantly, this Chapter will also examine Africa's role in leveraging these international programs to benefit and achieve socio-economic growth and development in Africa.

The various international programs addressing the following socio-economic development challenges: agriculture and food security, environment and climate change, disaster, and security, will be examined.

There are a wide array of international programs, public and private initiatives supporting Africa's use of space technologies for addressing Africa's socio-economic development challenges. However, this research, particularly this Chapter, is limited in assessing all the available international programs supporting Africa's use of space technologies to solve Africa's socio-economic development challenges. For this reason, specific international programs will be assessed in this research.

2.1. International Programs Supporting Africa in Addressing Agriculture and Food Security Challenges through Space Technologies

African countries who are users of space, consumers of space products, and players in the space industry in Africa can be grouped into three main categories: passive users, active users, and active developers. African countries that fall under the category of passive users do not have any space capabilities, and they only obtain processed information. Active users can process the data obtained while active developers include the African States with space capacity, typically a space agency, and advanced space policies.[53] This research primarily focuses on the African States that are active users and active developers. However, the conclusion and recommendation of this research will be helpful to all types of users in the African space industry.

Different international programs support Africa in addressing its agriculture and food security challenges through space technologies and data from space technologies like earth observation satellites, communication, and navigation satellites. Some of these international programs are examined below;

2.1.1. The United Nations Programme on Space Applications

The United Nations is keen on supporting Africa in maximizing space technologies for Africa's development needs and bringing the benefits of space to Africa. The space-related undertakings of the United Nations system focus on environmental security and management of natural resources; the utilization of space applications for human safety; advancement of communications and global navigation satellites for development; and capacity building and education in space applications for sustainable development.[54]

The UN Programme on Space Applications was created on the commendation of the first UNISPACE Conference, with a mandate to create awareness on the benefit of space technology among policymakers and government agencies and to assist developing countries in acquiring the knowledge, skills, and practical experience necessary for the application of space technologies.[55] The UN Programme on Space Applications is executed by the United Nations Office for Outer Space Affairs (UNOOSA).

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[53] Kai-Uwe Schrogl et al, *Handbook of Space Security: Policies, Applications and Programs*, 2nd ed (Switzerland: Springer, 2020).

[54] *Space Benefit for Africa: Contribution of the United Nations Family*, UNCOPUOS, UN Doc A/AC.105/2009/CRP.4 (2009) at 1.

[55] "History of the United Nations Programme on Space Applications" online: *UNOOSA* <www.unoosa.org/oosa/en/ourwork/psa/history.html>

Under the UN Programme on Space Applications framework, the Office for Outer Space Affairs organizes capacity-building workshops on space applications and data that contribute to sustainable socio-economic development programmes focused on agriculture and water security, mainly in developing countries.

Following the mandate of the Programme, the Office for Outer Space Affairs, under the framework of the Programme, has organized about 300 training courses, workshops, seminars, and conferences and provided funding to support about 18,000 participants, mostly from developing countries. The Programme also cooperates with academic institutions globally by providing long-term fellowships in fulfilling the capacity-building mandate of the Programme.[56] Also, in collaboration with the International Academy of Astronautics, the United Nations organizes annual workshops on the benefit of small satellites for developing countries.[57]

These workshops and training are essential for knowledge development and the advancement of technical capacity in the African space industry. However, the duty lies with each Country to ensure that these workshops and training are not merely opportunities for travel but a knowledge acquisition avenue for their representatives and an opportunity to translate the knowledge acquired into critical actions for capacity building.

From 1991-2004, the UN Space Programme organized workshops that addressed "the status of basic science in Africa, Asia and the Pacific, Latin America and the Caribbean, and Western Asia. The workshops contributed to the inauguration of small astronomical facilities for research and education programmes at the university in developing countries".[58] However, according to the research data from the International Astronomical Union, most countries in Sub-Saharan Africa still have underdeveloped astronomical research institutions/facilities.[59]

With the advancement of space technologies, and the growing number of space actors and states desirous of developing space technologies (including small satellites) to meet the space development needs of their Country, there has been substantial growth in the development of space technologies in the last decade. Following the advancement of space technologies and the need to promote research and capacity building of space technologies, the UN Programme on Space Applications launched the United Nations Basic Space Technology Initiative

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[56] *United Nations Programme on Space Applications*, UNOOSA, 2012, UN Doc ST/SPACE/52/REV 1, V.12-5542 (2012) at 1.

[57] "United Nations Programme on Space Applications" (2012) 183 Space Research Today J at 7.

[58] *Supra*, note 54.

[59] "Astronomy for Development: Strategic Plan 2010-2020" online (pdf): *International Astronomical Union* <www.iau.org/static/education/strategicplan_2010-2020.pdf>

(UNBSTI) to support capacity building in basic space technology. In achieving the mandate of this initiative, "the programme will organize workshops and training courses, develop an education curriculum and provide long-term fellowship opportunities and a framework for international cooperation in the development and use of basic space technology and its applications."[60]

The United Nations Space Programme is a great initiative that can assist developing countries in building technical capacity to develop space technologies like small satellites for Africa's benefit. Despite the training and programs of the UN Space programme, there remains a technical space technology development gap in Africa. Most space-faring African States still lack the technical capacity to develop and launch satellites and exploit space technologies for Africa's development. Therefore, these training and programs have either been limited in achieving technical space capacity development in Africa; or the knowledge and skills acquired from the training have not been fully utilized to promote space technologies for Africa's socio-economic development. For either situation that it may be, a change in strategy is crucial to develop indigenous space technology capacity in Africa and expand programs for exploiting space technologies for Africa's development.

2.1.2. United Nations Economic Commission for Africa (ECA)

The United Nations Economic Commission for Africa (ECA) is one of the five regional commissions of the United Nations, established in 1958 by the Economic and Social Council of the United Nations.[61] The ECA has the mandate to promote the socio-economic development of member states, foster intra-regional integration, and promote international cooperation for Africa's development.[62] The ECA's role in promoting space development in Africa is in space technologies like remote sensing and telecommunications by providing technical advisory services to member states and sub-regional organizations supporting spatial information technologies. The ECA is also involved in research on advocacy and policy analysis, the organization of workshops and seminars, and expert group meetings.

The ECA occupies a vital position in addressing Africa's socio-economic development challenges and ultimately driving Africa's development, particularly by taking a leadership

[60] Werner Balogh, et al. "The United Nations Programme on Space Applications: Status and Direction for 2010" (2010) 26:3 Space Policy J at 186.

[61] "Overview: From Ideas to Actions for a Better Africa" online: *UNECA* <www.archive.uneca.org/pages/overview>

[62] "From Ideas to Actions for a Better Africa: Who We Are", online: *United Nations Economic Commission for Africa* <www.uneca.org/about>

position in guiding leaders and Member States in advocating, proposing, and driving policies towards maximizing space technologies and the benefits of space exploration for sustainable development in Africa.

In cognizance of the unique position of the ECA in fostering Africa's socio-economic development, various international organizations and UN agencies partner with ECA to promote initiatives addressing Africa's socio-economic development challenges. For example, WHO, in partnership with ECA, the International Telecommunication Union (ITU), and the African Union Commission, led the Africa Health Infoway Initiative. The Africa Health Infoway initiative seeks to improve health information management in Africa using space technologies like satellite-based communication.[63] ECA supports Member States in developing and maximizing their geo-information resources, advancing policies, standards, and enabling legal structures for spatial information-based assessments and decisions.[64]

Also, the ECA collaborates with the African Union Commission to promote space applications for sustainable development in Africa and achieve the goals of the African Union Agenda 2063. The ECA also promotes space technologies to identify potential sites for disaster, disaster monitoring, and risk management in assessing the impacts of disasters on the environment.

ECA collaborates with the Office for Outer Space Affairs to ensure that Charters like the International Charter Space and Major Disasters are accessible to all African countries. Almost all Charter activations in Africa were made possible through the collaborative and cooperative efforts between different United Nations entities.[65]

The ECA occupies a crucial position in advancing space technologies for space development in Africa, being the cardinal body that foreign institutions and organizations enter into partnership with to advance Africa's development. Therefore, the ECA and the African Union are critical organizations that can drive programs and policies for Africa's development. While the ECA and the African Union remain committed to driving Africa's development, both organizations need to encourage Member States further and carry them along in policymaking and governance structures to promote space technologies for each Member State and Africa. It is crucial to actively carry Member States along because ultimately, the policies and decisions taken at the African Union on promoting space science in Africa will be implemented by the Member States. Member States must understand the importance of space science and technology to their State. This understanding will encourage the government to enact laws and

[63] *Supra*, note 54 at 9.
[64] Ibid at 13.
[65] Ibid at 16.

policies promoting space science in their region and make the most of international programs at their disposal.

2.1.3. The Food and Agriculture Organization of the United Nations (FAO)

The Food and Agriculture Organization (FAO) is a specialized United Nations agency leading global efforts to defeat hunger. The goal of the FAO is to attain food security for all and ensure regular access to high-quality food for all to live and lead healthy lives.[66]

The FAO has carried out various projects to support member states, including African states, in promoting and enhancing sustainable agriculture practices, towards attaining food security. In carrying out its capacity building responsibilities, the FAO established the Multilateral Environmental Agreements in African, Caribbean, and Pacific countries (ACP MEAs 3), an initiative aimed at promoting environmental sustainability in African, Caribbean, and Pacific (ACP) countries through the strengthening of environmental governance and the implementation of Multilateral Agreements (MEAs).[67] A stakeholder analysis of this project carefully notes the importance of proper coordination and maximum participation of all stakeholders, including the African Union and the AU Regional Economic Communities, for the project's success.

The United Nations Conference on Trade and Development (UNCTAD) also fosters South-South cooperation in building the technical know-how of developing countries on the use of satellite data to monitor the state of crops for increased agricultural production.[68] In building the capacity of developing countries to exploit space technologies for agriculture, participants from 12 countries (including South Africa and Nigeria) completed a two-month online training on the CropWatch Innovative Cooperation Programme (CropWatch-ICP).[69] The CropWatch-ICP Programme promotes crop monitoring systems using satellite data. Providing feedback on the online training, Rakiya Baba Maaji (Assistant Director of the Nigerian National Space Research Development Agency - NASDRA) said, "we have always wanted to use space technologies but the push was not there. But with this programme, we are able to make a good

[66] "About FAO", online: *Food and Agriculture Organization of the United Nations* <www.fao.org/about/en/>
[67] "Building Capacity Related to Multilateral Environmental Agreements in Africa, Caribbean and Pacific Countries (ACP MEAs 3)"online: *Food and Agriculture Organization of the United Nations* <www.fao.org/in-action/building-capacity-environmental-agreements/en/>
[68] "Developing Countries Use Space Technology to Combat Food Insecurity" (June 2021), online: *reliefweb* <www.reliefweb.int/report/world/developing-countries-use-space-technology-combat-food-insecurity>
[69] "Developing Countries Use Space Technology to Combat Food Insecurity" (2021), online: *UNCTAD* <www.unctad.org/news/developing-countries-use-space-technology-combat-food-insecurity>

presentation to our boss and we are excited about the next steps."[70] This statement by the Assistant Director at NASDRA evidences the gap in Nigeria's technical know-how and capacity to harness space technologies for Africa's socio-economic development. While international programs are great in supporting Africa to develop space technology capacity, the ultimate responsibility to make the most of the international programs to develop indigenous space capacity lies with each Member State.

This research did not find any concrete programs or initiatives that NASDRA has commenced or implemented following this training. Hopefully, the Agency will take further steps to implement the knowledge from this training in the near future.[71]

It is also crucial for the space agencies of African states to take steps to foster indigenous space capacity beyond relying on international programs actively. It is unsustainable for Africa to fix an unending reliance on international support in developing space capacity. Each member state knows the peculiar issues that threaten their State's socio-economic development. Member States are therefore in the best position to know what path to take in addressing these socio-economic development issues.

Effective governance structures and policies are essential for promoting sustainable agriculture practices in Africa and globally. Advancing efficient governance mechanisms and policy coherence between sustainable agriculture development, food systems, environmental concerns, social protection, education, and institutions can promote sustainable agricultural development at national and international levels.[72] The process of attaining sustainable agriculture can be accelerated "not only through scientific and social approaches but also by appropriate laws and policies. Several policy considerations could potentially assist countries in their efforts to harness science and technology for food security and build agricultural innovation systems as part of broader agriculture-led strategies for sustainable development".[73] Law and policies give life to driving the active participation of stakeholders in the African space industry to promote initiatives towards developing space technology capacity in Africa.

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[70] Ibid.

[71] While training are important, they amount to a waste of resources if knowledge acquired from the training are not put to best use. It is therefore important for the space agencies and governments of different African countries to ensure that officers who participate in various training give detailed report on knowledge acquired and make recommendation on how to implement initiatives and programs from the knowledge acquired during the training.

[72] *The Role of Science, Technology and Innovation in Ensuring Food Security by 2030*, UNCTAD, UN Doc UNCTAD/DTL/STICT/2017/5 (2017) at 28.

[73] Ibid at 31.

2.1.4. The United Nations World Food Programme (WFP)

Food production and market access are two essential factors in agriculture and food security. The World Food Programme is the biggest humanitarian agency fighting poverty globally.[74] The World Food Programme engages in research and programs towards fighting poverty in Africa. One of the studies carried out by the WFP in Africa is the Cost of Hunger in Africa (COHA) Series which estimates the socio-economic effects of undernutrition in children, providing data to support investments in human capital for sustainable development in Africa.[75] The COHA is led by the African Union Commission and implemented by Member States. The study outcomes offer comprehensive data to inform policy dialogues and promote advocacy around the significance of preventing child undernutrition.[76]

Space applications are vital tools for solving poverty and food security issues, and the WFP leverages space technologies in fighting poverty globally. One of the instances in which the WFP leverages space tools in fighting poverty is using satellite imagery to monitor rainfall patterns across the Sahel to estimate and predict rainfall and drought.

The WFP also uses space tools in assessing, monitoring, and responding to disasters as satellite imagery plays a vital role in increasing the proficiency of humanitarian response by the WFP.[77] WFP and FAO have executed various initiatives within the framework of the Global Monitoring and Food Security project of the European Space Agency on food security in Africa through agricultural meteorology. Ethiopia, Sudan, and Uganda were three pilot countries selected to apply a new methodology for estimating cultivated areas through radar data at the start of the cultivation season.[78] WFP and FAO have made significant progress in supporting Africa's Agriculture and food security. Many Africans still live in extreme poverty with little to no access to clean water and decent food. Therefore, Member States need to expand these various programs by WFP and FAO to attain food security in Africa through the ECA and the African Union. Food security programs by the space agencies in Africa, in partnership with research institutions both within and outside Africa, can exploit space applications for food security in Africa, just like the NASA Food Security Programme.

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[74] "Who we Are" online: *United Nations World Food Programme* <www.wfp.org/who-we-are>

[75] "The Cost of Hunger in Africa: Social and Economic Impact of Child Undernutrition" (2020), online: *United Nations World Food Programme* <www.wfp.org/publications/cost-hunger-africa-series>

[76] Ibid.

[77] Shelley Thakral, "Technology in Emergencies Gives Us the Bigger Picture. It Helps Us Find Solutions" (2018), online: *United Nations World Food Programme* <www.wfp.org./stories/technology-emergencies-gives-us-bigger-picture-it-helps-us-find-solutions>

[78] *Supra*, note 54 at 7.

2.1.5. The Geodata for Agriculture and Water (G4AW)

The G4AW initiative, executed by the Netherlands Space Office and the Ministry of Foreign Affairs of the Netherlands, undertakes various projects across Africa and Asia to leverage space technologies for agriculture and food security.

Some of the G4AW Projects in Africa include the CommonSense Project in Ethiopia. This project is targeted at smallholder farmers in Ethiopia, providing them with actionable information based on Earth Observations and geographic data, dedicated dashboards for crop condition monitoring, and risk assessment based on satellite and weather data.[79] In Burkina Faso, the G4AW implements the Mobile Data for Moving Herd Management and Better Incomes (MODHEM) project. This project aims to enhance the food security condition of pastoralists and farmers by providing them with satellite data on the best locations for pastures and water areas via their mobile phones.[80] However, this great initiative is faced with the limitations of stable mobile network and internet connection challenges prevalent in most African countries. Also, the use of a mobile phone in some parts of Africa, especially the rural regions, is not a 'luxury' most families in the rural area can afford.

In Kenya, the G4AW implements the Crop Monitoring Service (CropMon) project, which aims to "develop an affordable crop monitoring service that provides smallholder and medium-sized farmers in Kenya with location-specific and timely information about the actual status of their crops. Additionally, possible causes of yield depressions are given and corrective measures to overcome this."[81]

In Mali, the G4AW advances the Sustainable Technology Adaptation for Mali's Pastoralist (STAMP). This project aims to enhance flexibility among climate-affected pastoralists by providing access to data derived from geo-satellites. The service for the STAMP project is also offered to subscribers on their mobile phone, for which they pay a modest fee per USSD requests.[82]

In South Africa, the G4AW implements the Rain for Africa (R4A) project to provide enhanced and standardized rainfall information for National Weather Services, local/regional weather data for service providers, sowing and spraying advice for food producers in Africa for a reasonable fee.[83]

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[79] "Overview of the G4AW Projects" (2016) online (pdf): *Spacefordevelopment* <www.spacefordevelopment.org/wp-content/uploads/2018/06/G4AW-Details-of-projects-LR-24082016.pdf>

[80] Ibid at 4.

[81] *Supra,* note 79 at 5.

[82] Ibid.

[83] Ibid at 8.

The G4AW maximizes space technologies in different countries in Africa to solve a significant socio-economic development challenge: agriculture and food security. G4AW leverages space technologies across African states that are passive users, active users, and active developers of the space industry. The G4AW project can be instrumental in advancing the development of the space capacity of African states that are passive users in the space industry through their work in those regions, which exploits and promotes space technologies to solve their agriculture and food security challenges. Also, the G4AW project is essential for enlightening the government and policymakers to make informed decisions and advance innovative policies for addressing the challenge of agriculture and food security in their region.

Specifically, the specialized Geodata for Agriculture and Water Scaling Up Micro-Insurance in Africa (G4AW SUM) Project aims to improve Agriculture and food security in developing countries through the use of satellite data. It also seeks to support the extensive adoption of space technologies for food security.[84] The G4AW SUM Africa project uses satellite data to generate low-cost insurance products for farmers in Mali and Uganda. This insurance allows smallholder farmers to obtain credit for increased crop production, thereby enhancing their profits and livelihoods.[85] Agricultural index insurance products are associated with an index[86] rather than tangible loss. Hence, meteorological satellites are used for the constant monitoring of climate conditions for crop yield. These satellites provide timely information used by insurance companies for risk assessment, insurance pricing, and calculation of pay-outs.[87] Therefore, farmers have lower transaction costs because insurance companies no longer have to visit farmers to assess their loss and determine payout.[88]

In Uganda, the government makes a premium subsidy contribution to the G4AW SUM Africa project to provide satellite-based drought index insurance to protect farmers in Uganda. The Dutch company EARS and its partners, including the Ugandan Agro Insurance Consortium (AIC), continue to deliver innovative insurance solutions for climate-smart agriculture throughout Africa.[89]

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[84] "Scaling Up Micro-Insurance in Africa (SUM Africa)" (2018), online (pdf): *G4AW* <www.g4aw.spaceoffice.nl/files/files/G4AW/project%leaflets/A4%20leaflet%20SUM%20Africa%20July%20LR.pdf>

[85] "Transforming Africa's Food System through Low-Cost Insurance Products" online: *G4AW* <www.g4aw.spaceoffice.nl/en/g4aw-projects/g4aw-projects/16/sum-africa.html>

[86] Index such as temperature, rainfall, crop yield or evapotranspiration.

[87] *Supra,* note 85.

[88] Ibid.

[89] "Innovative Insurance Service for Farmers Based on Satellite Data Gets Commercial Follow Up in Uganda" (2019), online: *Food & Business Knowledge Platform* <www.knowledge4food.net/innovative-insurance-service-farmers-based-on-satellite-data-commercial-follow-up-uganda/>

This project has made progress and also encountered some challenges. The project has insured about 70,000 coffee farmers[90] in Uganda against produce loss following adverse weather that can potentially affect crop yield. However, the project's situation in Mali is different as the country's lack of infrastructure and security challenges have hampered this project's success. Unfortunately, the lack of infrastructure and security challenges is not peculiar to Mali. Most African States are plagued with security issues and the lack of infrastructure, which impedes most international programs and projects for Africa's development. However, these are issues that must be addressed to maximize the benefits of the various international programs and support at Africa's disposal. Relevant laws and governance structure that promotes leveraging space tools to address security issues in various parts of Africa and build adequate infrastructure to support the realization of these programs are essential.

2.1.6. *The United Nations Educational, Scientific, and Cultural Organization (UNESCO)*

UNESCO primarily aims to develop intercultural understanding through heritage protection, support for cultural diversity, universal access to quality education, scientific cooperation, development, and human dignity. However, UNESCO also supports space technology development by creating awareness among member states on the potentials of space applications for humankind's use and benefits. In achieving this space technology development, UNESCO's space activities are channeled or achieved through three forums mainly; (a) the Global Ocean Observing System (GOOS), implemented by the UNESCO-International Oceanographic Commission; (b) Earth Observation implemented through the Global Earth Observation (GEO) forum, and (c) the World Heritage Convention supported by UNESCO space partners.

In promoting innovative solutions addressing agriculture and food security challenges in Africa, UNESCO's Division of Water Sciences developed a regional plan for executing the TIGER initiative in Africa. The TIGER initiative seeks to develop national competence in water reserve management in Africa. "The European Space Agency launched the TIGER initiative to promote the use of earth observation for improved Integrated Water Resources Management (IWRM) in Africa."[91]

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[90] Ruud Grim "How Space Technology is Transforming Africa's Food System through Low-Cost Insurance Products for Smallholders" (22 October 2018), online: *Group on Earth Observations* <www.earthobservations.org/geo_blog_obs.php?id=322>

[91] "Tiger Initiative: Looking After Water in Africa" online: *ESA* <www.tiger.esa.int/index.php>

The TIGER initiative is "an international collaboration founded in the context of the Committee of Earth Observation Satellites (CEOS) with an increasing number of strategic partners involved."[92] UNESCO partners with the African Union, the New Partnership for African Development, and relevant UN agencies in science-related disciplines to promote science and technology in Africa.[93]

The success of UNESCO's work in supporting Africa's science and technology development is also largely dependent on partnership with African stakeholders and political support from the government of Member States.

2.2. International Programs Supporting Africa in Addressing Disaster Management and Security Challenges through Space Technologies

2.2.1. *The United Nations Office for Disaster Risk Reduction (UNDRR)*

The United Nations Office for Disaster Risk Reduction (UNDRR) was established to aid the implementation of the International Strategy for Disaster Reduction (ISDR).[94] The ISDR aims to build disaster-resilient societies by advancing knowledge on the significance of disaster reduction as a fundamental part of sustainable development in every Community. In supporting Africa in maximizing space technologies for disaster risk reduction and disaster management, ISDR established its regional outreach office in Nairobi. In collaboration with NEPAD (New Partnership for Africa's Development), African Union Commission, African Development Bank, UNDP, and UNEP, ISDR Africa developed the African Regional Strategy for Disaster Risk Reduction to promote the incorporation of the strategy into the development programme of African countries.[95]

The UNDRR supports the implementation, follow-up, and review of the Sendai Framework for Disaster Risk Reduction. "The UNDRR is the mandated focal point for disaster risk reduction in the UN system. The Sendai Framework for Disaster Risk Reduction 2015-2030

[92] "Tiger Initiative: Looking After Water in Africa" online: *ESA* <www.tiger.esa.int>

[93] "Partnerships" online: *UNESCO* <www.unesco.org/new/en/natural-sciences/about-us/how-we-work/partnerships-and-networks/partnerships/>

[94] "United Nations Office for Disaster Risk Reduction (UNDRR)" online: *PreventionWeb* <www.preventionweb.net/organizations/1171>

[95] "Disaster Risk Reduction for Sustainable Development: Africa Regional Strategy for Disaster Risk Reduction" (2004), online (pdf): *Preventionweb* <www.preventionweb.net/files/7603_AFRICAREGIONALDRRSTRATEGYfullPDF.pdf>

(Sendai Framework) is the agreed global blueprint for reducing risk and building resilience".[96] The Sendai Framework is also applicable to Africa in guiding Africa's disaster risk reduction and mitigation guidelines and policies.

The work of the UNDRR in Africa is facilitated through the UNDRR Regional Office for Africa (UNDRR AF). UNDRR AF promotes national ownership of the disaster reduction cycle by providing distinct support for creating national platforms with national governance and expenditure allocation.[97] The UNDRR regional office for Africa is located in Nairobi, Kenya, and partners with the African Union Commission, five Regional Economic Communities (RECs), and other development partners. UNDRR Africa also has a liaison office in Addis Ababa, Ethiopia, supporting the African Union Commission in implementing the 'Program of Action for implementing the Sendai Framework in Africa.'[98] The presence of a UNDRR regional office in Africa facilitates the work of UNDRR on disaster management in Africa. The proximity of the regional office makes it possible to understand and appreciate Africa's unique challenges with disaster reduction and management and promote policies and programs towards addressing these challenges.

2.2.2. *The Sendai Framework for Disaster Risk Reduction (2015-2030)*

The Sendai Framework for Disaster Risk Reduction[99] is a fifteen-year international framework for disaster risk reduction, response, and management.

According to the 2018 Annual Report of the United Nations Office for Disaster Risk Reduction, one of the goals of the Sendai Framework is to increase international collaboration with developing countries through ample and sustainable support to complement the national actions of developing Countries for implementing the Sendai framework by 2030.[100] However, this target is only achievable following national actions carried out by developing countries to implement the Sendai Framework. This speaks to the need for developing countries, particularly African states, to develop national policies that will propel relevant stakeholders

[96] "UNDRR Work Programme 2020-2021: In Support of the Sendai Framework for Disaster Risk Reduction" online (pdf): *United Nations Office for Disaster Risk Reduction* <www.unisdr.org/files/68235_undrrworkprogramme20202021.pdf>

[97] United Nations Office for Disaster Risk Reduction – Regional Office for Africa (UNDRR AF) online: *PreventionWeb* <www.preventionweb.net/organizations/2626>

[98] "UNDRR Regional Office for Africa" online: *UNDRR* <www.undrr.org/about-undrr-where-we-work/africa>

[99] The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the Third United Nations World Conference on Disaster Risk Reduction on 18 May 2015 in Sendai, Japan.

[100] "United Nations Office for Disaster Risk Reduction 2018 Annual Report" (2019), online: *UNDRR* <www.unisdr.org/files/64454_unisdrannualreport2018eversionlight.pdf>

in their Country to take necessary steps in achieving international programs like the Sendai Framework and leverage international support and programs when necessary. Sole reliance on international programs is unsustainable for Africa's socio-economic development. Developing countries need to play a present and active role in exploiting space technologies for development through viable laws and policies. It is also vital to make conscious efforts not to overburden the international system and programs that support developing countries. The Sendai Framework "recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector, and other stakeholders."[101] This further stresses the primary responsibility of African States to play an active role in addressing its socio-economic development issues, including disaster risk reduction and management. Undertaking public-private partnerships is another viable means of promoting space technologies for Africa's socio-economic development challenges. Chapter three of this work will examine the national laws and policies of the identified African States for this research, particularly the provisions that promote private space activities and public-private partnerships to achieve international programs like the Sendai Framework.

2.2.3. *The United Nations Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER)*

UN-SPIDER was established in 2006 under the United Nations Office for Outer Space Affairs (UNOOSA). UN-SPIDER advances solutions to tackle the limited access of developing countries to space technologies for disaster risk reduction and management.[102] UN-SPIDER is charged with the mandate to enable developing countries to use space-based information in all phases of the cycle of disaster management.

The UN-SPIDER programme of UNOOSA continues to provide technical advisory support to various African Countries to enable the use of space technologies and space-based data for disaster risk reduction and management.[103] Taking advantage of international partnerships to exploit space technologies for disaster risk reduction and management, the Nigerian National

[101] "What is the Sendai Framework for Disaster Risk Reduction?" online: *UNDRR* <www.undrr.org/implementing-sendai-framework/what-sendai-framework>

[102] "United Nations Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER)" online: *United Nations Office for Outer Space Affairs* <www.unoosa.org/oosa/en/ourwork/un-spider/index.html>

[103] "UN-SPIDER/NASDRA/NEMA/ZFL Virtual Expert Meeting Discusses Space-Based Solutions for Disaster Risk Management and Emergency Response in Nigeria" online: *PreventionWeb* <www.preventionweb.net/news/views/77220>

Space Research and Development Agency (NASDRA) signed a cooperation agreement with UNOOSA to become a Regional Support Office in June 2009. By June 2011, UN-SPIDER conducted a technical advisory mission to Nigeria to note the developments in space technologies for disaster management.[104] During the annual session of the Committee on the Peaceful Uses of Outer Space, in June 2019, the Office for Outer Space Affairs and the University of Bonn signed a cooperation agreement to continue the efforts initiated by UN-SPIDER in Africa in the following five years. The cooperation agreement also covers technical advisory support to African States, including organizing international conferences and expert meetings in Bonn and regional expert meetings in African countries.[105] This cooperation agreement which focuses on African States is in tandem with regional and international frameworks like the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction 2015-2030, and the 2063 Agenda of the African Union.[106] This cooperation agreement will help achieve the goals and objectives of the above regional and international frameworks and support Africa in achieving sustainable development.

The issue of flooding has plagued different African States, including Nigeria, and continues to pose threats to the lives and livelihood of citizens. The country's economic hub, Lagos State, is not spared of the menace of flooding, which continually disrupts business and has severe economic implications for foreign investors and local businesses.

The UN-SPIDER generates maps of areas impacted by floods and droughts in Nigeria through satellite imagery and provides this data to the National Emergency Management Agency of Nigeria (NEMA) and NASDRA. Also, experts from Nigerian institutions and universities have undergone training at conferences like the UN-SPIDER international conference. Notably, there was a joint Virtual Expert Meeting on the use of Space-Based Solutions for Disaster Risk Management and Emergency Response in Nigeria by UN-SPIDER, NASDRA, NEMA, and the Center for Remote Sensing of Land Surfaces of the University of Bonn (ZFL) held from the 13th – 15th of April, 2021. The meeting aimed to contribute to the efforts of NEMA on disaster risk reduction, preparedness, early warning systems, disaster response, and

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[104] Ibid.

[105] *Report on the Bonn International Conference on the Theme "Space-based Solutions for Disaster Management in Africa: Challenges, Applications, Partnerships", UNCOOPOUS*, UN Doc AC.105/1223 (2019) at 2.

[106] "UNOOSA Signs Cooperation Agreement with the University of Bonn to Help Member States Leverage Space-Based Information in All Phases of Disaster Management" (2019), online: *reliefweb* <www.reliefweb.int/repirt/world/unoosa-signs-cooperation-agreement-university-bonn-help-member-states-leverage-space>

recovery.[107] So far, there have been very little to no efforts concerning early warning systems on disasters in Nigeria, especially on flooding. In the recent heavy downpour of rain in Lagos, Nigeria, on 16 July 2021, several parts of the state experienced severe flooding, which destroyed several properties and affected various businesses. In addition to poor warning on this disaster, there were minimal efforts from the relevant agencies to address this lingering issue immediately. While the Nigerian Meteorological Agency (NiMET) sometimes provides impending environmental disaster warnings, this is not a consistent practice. This evidences the need for Nigeria and Africa to take intentional steps in translating international training, programs, and support into visible actions that optimizes these programs and makes it all worth it. Data that is not translated and implemented to solve the issues relating to the data remains nothing but data and a waste of resources.

The Nigerian Space Research Development Agency (NASDRA) is a member of the International Charter Space & Major Disasters, working with other space agencies and operators to provide satellite imagery for disaster monitoring and management. Also, NigeriaSat-1 is one of the Disaster Monitoring Constellation (DMC) satellites built to address the need for regular reassessment and international coverage to monitor natural disasters, providing satellite imagery for disaster management.[108] Unfortunately, concerning disaster management in Nigeria, the country, like many other African States, cannot be said to have successfully harnessed space technologies for early warning systems, risk reduction, and disaster management.

2.2.4. *The United Nations Institute for Training and Research/Operational Satellite Applications Programme (UNITAR/UNOSAT)*

The United Nations Institute for Training and Research (UNITAR) conducts capacity development and research activities globally, as the United Nations training division.

"The Operational Satellite Applications Program (UNOSAT) of UNITAR is a technology-intensive programme delivering imagery analysis and satellite solutions to relief and development organizations within and outside the United Nations system to help make a difference in critical areas such as humanitarian relief, human security, and strategic territorial

[107] "Space-Based Solutions for Disaster Risk Management and Emergency Response in Nigeria" online: *United Nations Office for Outer Space Affairs: UN-SPIDER Knowledge Portal* <www.un-spider.org/news-and-events/events/un-spider-expert-meeting-space-based-solutions-Nigeria>

[108] Dr. Ganiy I. Agbaje "Current Trends in Nigeria's Space Development Programme to Facilitate Geospatial Information (GI) Sharing and Implementation of the NGDI" (2008), online(pdf): *U.S. Department of State* <www.2001-2009.state.gov/documents/organization/110820.pdf>

and development planning."[109] UNITAR is particular about strengthening the capacity of individuals from developing countries, especially individuals from countries in peculiar circumstances.[110] The UNOSAT team uses the research and innovation skills of the team together with relevant partnerships to make the benefits of satellite applications and geospatial information through professional imagery analysis and Geographic Information System Solutions available to various Countries, including developing Countries.[111] UNOSAT also aims to develop the capacity of member states for geo-information technology towards achieving the SDGs. UNOSAT provides 24/7 emergency mapping services to humanitarian relief agencies and national disaster management authorities.[112] Over the years, UNOSAT has produced maps for disaster management in various parts of Asia and Africa. Between 2003 and 2014, UNOSAT produced over two hundred maps[113] for Africa and Asia, using space technologies. For example, in the wake of the Nyiragongo volcano northeast of the Democratic Republic of Congo (DRC), the UNOSAT's rapid mapping service was activated, following which UNOSAT triggered the International Charter Space and Major Disasters to access all available satellite images of the region. UNOSAT then commenced preliminary assessments of the lava flow extent, direction, and damages caused.[114] During the Ebola outbreak in West Africa, UNOSAT provided high-resolution custom-made maps for the World Health Organization (WHO) to map areas affected by Ebola. These high-resolution maps, directly accessible on the WHO internal information system, supported the WHO's work in building Ebola Treatment Centers and distributing personnel across the affected countries, especially in highly remote areas where information is limited and often outdated.[115] The success of UNITAR/UNOOSAT's work in Africa should be expanded through strategic partnerships and progressive policies. This is important because African States like Nigeria, for example, is a

[109] *Space for Agriculture Development and Food Security: Use of Space Technology Within the United Nations System*, UNOOSA, UN Doc ST/SPACE/69 (2016) at 23.
[110] United Nations Institute for Training and Research: Report of the Secretary-General, ECOSOC, UN Doc E/2019/81 (2019) at 5.
[111] UNITAR/UNOSAT Brief: Satellite Applications for Human Security (2011), online (pdf): *Reliefweb* <www.reliefweb.int/sites/reliefweb.int/files/resources/UNOSAT_Brief_Sat_App_for_Human_Sec_2011_0.pdf>
[112] "UNITAR Operational Satellite Applications Programme (UNOSAT)" online: *UNOOSA: UN-SPIDER Knowledge Portal* <www.un-spider.org/space-application/emergency-mechnisms/unitar-operational-satellite-applications-programme-unosat>
[113] Manuel Fiol "Introduction to UNOSAT & Mine Action Related Activities" (2015), online (pdf): *GICHD* <www.gichd.org/fileadmin/GICHD/what-we-do/events/UNMAT-2015/Statements-UNMAT-2015/07_Cooperation_Standards_and_Tools_09_UNOSAT_UNITAR_Manuel_Fiol.pdf>
[114] "Monitoring the Nyiragongo Eruption in DRC and Rwanda" (2021), online: *UNITAR* <www.unitar.org/about/news-stories/news/monitoring-nyiragongo-eruption-drc-and-rwanda>
[115] Katarina Anthony "UNOSAT Joins the Fight Against Ebola" (2014), online: *CERN* <www.home.cern/news/news/cern/unosat-joins-fight-against-ebola>

member/partner of international programs like the International Charter Space & Major Disasters and continue to provide international support through satellite imagery for disaster management to Countries in disaster. Africa will benefit immensely from expanding and leveraging programs like this.

2.2.5. *The Addis Ababa Action Agenda (AAAA)*

The Addis Ababa Action Agenda is the financial framework aimed at the implementation of the 2030 Agenda for Sustainable development. It provides a new global framework for financing sustainable development by aligning all financing flows and policies with economic, social and environmental priorities.

The Addis Ababa Action Agenda is crucial to financing technologies for Africa's development. The Agenda addresses issues of finance and cooperation on technology, science, innovation, trade, and capacity building. The Agenda also reaffirms commitments to official development assistance, particularly for the least developed countries, including pledges to increase South-South cooperation and mechanisms to facilitate the financing of new technologies for developing countries.[116]

The Agenda aims to "end poverty and hunger, and achieve sustainable development in its three dimensions through promoting inclusive economic growth, protecting the environment, and promoting social inclusion."[117] The AAAA is a financing and development framework towards adequate financing and policy consistency to achieve the Sustainable Development Goals (SDGs). The Agenda aims to mobilize public and private resources and establish suitable public policies and regulatory frameworks to promote private finance, trade, and technology development.[118]

In highlighting how to reduce the cost of delivering sustainable development, the Agenda underlines better governance through improved procurement, strengthened auditing, reduced

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[116] "The Future of Food and Agriculture: Trends and Challenges" (2017), online (pdf): *Food and Agriculture Organization of the United Nations* <www.fao.org/3/i6583e/i6583e.pdf>

[117] Addis Ababa Action Agenda of the Third International Conference on Financing for Development (2015), online (pdf): *United Nations Development of Economic and Social Affairs Financing for Development Office* <www.sustainabledevelopment.un.org/content/documents/2051AAAA_Outcome.pdf>

[118] "Towards Achieving the 2030 Agenda and the Sustainable Development Goals (SDGs): Report on the Implementation of the Addis Ababa Action Agenda on Financing for Development – Compilation of Operational Examples" (2017), online (pdf): *Government Offices of Sweden – Ministry of Foreign Affairs* <www.regeringen.se/49d52b/contentassets/f883444856cd40838e69a22d5da2beed/report-on-the-implementation-of-the-addis-ababa-action-agenda-on-financing-for-development?TSPD_101_R0=0840bf68c4ab2000d057e9bf9008641262ccf1154a05a142dce2dcf9efc120035e1ba3471ad530920854ffb1e9143000323693d51172c1af8a96e9f1e95ad3af78f5db8a622257452dcb49fbbbdfd3205bb79a68756b7791687184e9a366efca>

corruption and waste.[119] The highlighted cost reduction mechanisms for sustainable development are also crucial to African states to achieve sustainable development in Africa. Africa's socio-economic development challenges are laced with poor governance structure, human and capital resources mismanagement, and corruption.

In advancing sustainable development globally and achieving the SDGs, the Agenda recognizes that coping with climate change will be a significant challenge for several cities in developing countries already dealing with poor air quality, congestion, and inadequate housing infrastructure. Hence, in addressing this challenge, the Agenda supports the adoption of the Sendai Framework for disaster risk reduction and management.[120] The Agenda is also committed to capacity building for sustainable development in Africa through its Technology Facilitation Mechanism (TFM). However, the Technology Facilitation Mechanism of the Agenda has not achieved much in Africa regarding science, technology, innovation, and capacity building. Hopefully, the Agenda will make more progress on this in coming years as technology plays an essential role in assisting Africa in achieving sustainable development and the SDGs. Promoting policies that encourage private-public partnerships for indigenous and advanced technology capacity building in Africa will also assist Africa in achieving sustainable development and addressing Africa's socio-economic development challenges.

2.3. International Programs Supporting Africa in Addressing Environment and Climate Change Challenges through Space Technologies

2.3.1. *United Nations Environment Programme (UNEP)*

The United Nations Environment Programme (UNEP) is the foremost environmental authority and advocate for the environment. UNEP sets the global ecological plan and fosters the execution of the UN environmental sustainable development.[121] UNEP seeks to enhance the capacity of Member States to integrate, implement, and monitor the environmental element of Agenda 2030 in their respective countries. In achieving this, UNEP partners with other organizations like the United Nations Development Account and the Economic Commission for Africa to assist countries with developing national strategies and policies to achieve the

[119] Ajay Chhibber, "Assessing and Evaluating the Addis Ababa Action Agenda" (2016) National Institute of Public Finance and Policy Working Paper No. 166.
[120] Ibid.
[121] "Why Does UN Environment Programme Matter?" online: *UN Environment Programme* <www.unep.org/about-un-environment/why-does-un-environment-matter>

United Nations Agenda 2030, specifically on environment sustainability.[122] This speaks to the importance of national strategies and policies in achieving international programs and socio-economic development in any nation.

UNEP has a regional office in Africa that supports the government of Member States to interpret resolutions and reports made on natural resources into practical programs and novel solutions at the national, regional, and grassroots levels for Africa's benefit.[123] Also, "through Kigali Amendment Enabling Activities projects with 89 developing countries, UNEP helps promote integrated policy measures related to energy efficiency/climate considerations and the Montreal Protocol."[124]

According to the UNEP Global Environment Outlook Assessment for Africa report, Africa's socio-economic development and human livelihood are dependent on the sustainable management of Africa's natural capital. Africa's natural endowments like land and natural resources are threatened by contending uses, unsustainable management, climate change, and pollution.[125] Therefore, in promoting Africa's socio-economic development, it is essential to manage Africa's natural capital through adequate governance policies that advocate for and encourage a sustainable environment.

Africa can reduce its ecological imprint and conserve the life-support structure of healthy land, water, biodiversity, and air through low-carbon, climate-resilient infrastructure decisions and effective natural resource governance mechanisms.[126]

UNEP partners with UNOOSA in leveraging space technologies to address biodiversity and ecosystems management for observing endangered species, preventing poaching and environmental crime, and publishing atlases of global change and environmental assessments collected from Earth observation data.[127] UNEP also carries out various studies/research to identify African regions threatened by unsustainable environmental practices. The outcomes

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[122] "United Nations Environment Programme" online: *United Nations Department of Economic and Social Affairs: Sustainable Development* <www.sdgs.un.org/un-system-sdg-implementation/united-nations-environment-programme-unep-24515>

[123] "Our Work in Africa" online: *UN Environment Programme* <www.unep.org/regions/africa/our-work-africa>

[124] *Supra*, note 117.

[125] "UNEP Global Environment Outlook: GEO-6 Regional Assessment for Africa" (2016), online (pdf): *UN Environment Programme* <www.uneplive.unep.org/media/docs/assessments/GEO_6_Regional_Assessment_for_Africa_Final.pdf>

[126] Ibid at 135.

[127] Space Technologies for Monitoring and Protecting Biodiversity and Ecosystems: A Proposed New Thematic Priority for the United Nations Programme on Space Applications, UNCOPUOS, UN Doc A/AC.105/2015/CRP.10 (2015) at 3.

of the UNEP study help inform and influence government decisions and policies towards a sustainable environment in Africa.

In a recent study carried out by UNEP, the first sailing boat made from 100% recycled plastic (the Flipflopi) sailed over Lake Victoria (Africa's largest freshwater), reporting that the freshwater lake faces numerous environmental challenges that could affect the livelihood of the 40 million people living in the region. The Fliplopi initiative aims to showcase substitute uses of plastic waste and the prospects of circular economy methods. [128]

The Flipflopi journey over Lake Victoria and the report on the state of the Lake conveys a message to the members of the East Africa region who rely on the Lake for their means of livelihood on the need to clean up the Lake and embrace habits that avoid polluting the Lake, thereby promoting environmental sustainability in the region.

The waste management situation in most African cities is relatively poor, and there is an almost non-existing recycling culture. Most of the waste finds itself back into the environment as litter on the streets and in the drainages, which is also a major cause of flooding in various parts of Africa. Very little has been done regarding promoting sustainable and proper waste management and recycling culture in most cities in Africa. This poor recycling culture poses a significant threat to environmental sustainability. The government and relevant stakeholders need to make accommodations for proper waste disposal and suitable infrastructure for recycling plastic waste and implement laws that promote environmental sustainability. Private entities can also protect the environment by promoting sustainable environmental practices within their organization. However, a few private and non-governmental initiatives address the menace of plastic waste in different cities in Africa. For example, an international beverage alcohol producer, Diageo, co-founded the Africa Plastics Recycling Alliance to "collaborate and support plastics recycling in Sub Saharan Africa generating investments and jobs."[129]

[128] "Flipflopi Sets Sail Around Lake Victoria to Raise Awareness on Pollution Menace in East Africa" (2021), online: *UN Environment Programme* <www.unep.org/news-and-stories/press-release/flipflopi-sets-sail-around-lake-victoria-raise-awareness-pollution>

[129] "The Africa Plastics Recycling Alliance – Waste and Opportunity" (2019), online: *DIAGEO* <www.diageo.com/en/news-and-media/features/the-africa-plastics-recycling-alliance-waste-and-opportunity/>

2.3.2. *The Climate and Clean Air Coalition*

The Climate and Clean Air Coalition group carries out various assessments across Asia and Africa in partnership with the United Nations Environment Programme to achieve clean air and global environmental sustainability.

As part of its various studies, the Climate and Clean Air Coalition launched a scientific assessment on climate and clean air for Africa. This ongoing assessment seeks to determine how Africa can proceed simultaneously as limiting air pollution and its negative impact on agriculture, health, and the environment; and understand the potential to mitigate climate change in the near term and its implication for adaptation to climate change in Africa.[130]

This initiative embraces an inclusive level of participation by African stakeholders, including individuals, private entities, government, and policymakers involved in climate change and clean air for environmental sustainability in Africa. The outcome of this assessment will be essential in achieving the goals of the Africa Union Agenda 2063, especially on environmental sustainability. However, to successfully assess climate and clean air for Africa, this initiative requires support from the government and relevant stakeholders. The government's political buy-in and the support from stakeholders and industry partners are vital to the success of the various international programs to support Africa in overcoming its socio-economic development challenges.

[130] "Africa Integrated Assessment on Air Pollution and Climate Change" online: *Climate & Clean Air Coalition* <www.ccacoalition.org/en/activity/africa-integrated-assessment-air-pollution-and-climate-change>

2.4. CONCLUSION

Space technologies play a vital role in achieving both the United Nations Agenda 2030 and the African Union Agenda 2063, as they provide data helpful in achieving sustainable development in Africa. "Nevertheless, the benefits of space applications are not sufficiently communicated to decision-makers or the wider population, and there is not enough basic education at various levels to perform, manage, and operate space-based assets"[131] in Africa.

The 2014 Tokyo Conference on Combating Wildlife Crime emphasized the need for scientists, non-governmental organizations, national policymakers, and UN agencies to play a more active role in facilitating research and promoting an information-based decision-making process[132] for which data from space technologies and research play a vital role.

Also, academia and research institutions are core to the space technology capacity building of talents in Africa. However, academia and research institutions face limitations ranging from lack of technical experts in astronomy, meteorology, space law, and technology. Funding and lack of appropriate infrastructure in most universities and research institutions in Africa also contribute to the limitations of building indigenous technical capacity in the niche field of Space in Africa.

In developing technical space technology capacity in Africa, governments and policymakers need to prioritize the support and funding of academia and research institutions in space-related disciplines. Not much can be achieved without the government's support in this area.

The assessment of these international programs highlights the promising nature of these programs in supporting Africa's technical space capacity development for solving Africa's socio-economic development challenges. However, one thing stands out from the promising nature of these programs. The ultimate responsibility with owning the process of maximizing these international programs and exploiting space technologies and the benefits of space exploration for Africa's development ultimately lies with each African State. Advancing viable laws and appropriate governance structures will go a long way in supporting Member States in leveraging space technologies for Africa's socio-economic development.

Chapter three of this research will examine the national space laws and policies of Nigeria, South Africa, and Ethiopia to assess how their laws promote private sector participation, and the role of law in assisting each Country in fulfilling its international space obligations.

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[131] Schrogl et al, *Supra*, note 53.

[132] *Report on the United Nations/Kenya Conference on Space Technology for Wildlife Management and Protecting Biodiversity*, UNCOPUOS, UN Doc A/AC.105/1126 (2016) at 7.

CHAPTER III

THE LEGAL FRAMEWORK AND GOVERNANCE STRUCTURE FOR SPACE ACTIVITIES IN AFRICA: NIGERIA, SOUTH AFRICA & ETHIOPIA AS CASE STUDIES

3.0. Introduction

Space endeavors are not carried out in an environment devoid of regulations. The UN Space Treaties[133] provide the general international framework regulating space activities and the conduct of entities in outer space. In addition to the UN Space Treaties, non-binding UN Resolutions and 'soft law' guide the interpretation of the principles and obligations of international space treaties.

The most effective way for States parties to the UN Space Treaties to comply with the set obligations enshrined in the treaties is by enacting national space laws/regulations that aid each country in fulfilling their international obligations set out in the treaties.

"The requirement to implement international treaty obligations at the national level is inherent in international space treaties."[134] Harmonizing treaty obligations with national laws express the continuing resolve of a nation to support the crucial need for joint measures to manage international undertakings in a manner that guarantees the responsible use of outer space by all States as envisioned in the UN space treaties.[135]

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[133] The *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,* 27 January 1967, 610 UNTS 205, 6 ILM 386 (entered into force 10 October 1967) (hereinafter Outer Space Treaty (OST)).

The Convention on International Liability for Damage Caused by Space Objects, 29 March 1972, 961 UNTS 187, 10 ILM 965 (entered into force 1 September 1972) (hereinafter Liability Convention).

The Convention on Registration of Objects Launched into Outer Space, 12 November 1974 (entered into force 15 September 1976).

The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 19 December 1967 (entered into force 3 December 1968).

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 18 December 1979 (entered into force 11 July 1984).

[134] Ranjana Kaul & Ram S. Jakhu, "Regulation of Space Activities in India" (2010), online: *SSRN* <www.papers.ssrn.com/sol3/papers.cfm?abstract_id=2801723>

[135] Ibid at 157.

In reiterating the importance of a regulatory framework for space activities at the national level, the African Union Space Strategy noted that African States should institutionalize a regulatory framework to support Africa's space endeavors to ensure Africa's effective competition in the global space market in accordance with international treaties, conventions, and principles.[136] Following the assessment of the various international programs and commitments supporting Africa in leveraging space technologies for Africa's socio-economic development, it is crucial to analyze the domestic laws of the selected African States for this research (Nigeria, South Africa, and Ethiopia) in identifying potential gaps or challenges with their national space laws and any hindrance to its implementation, particularly its provisions for stimulating private sector participation and the mechanisms for implementing international obligations, programs and commitment.

A comparative analysis of the legal framework for space activities in India and Indonesia will be assessed. This chapter will also analyze the space law and policy implementation framework in the United States of America and Canada to identify any lessons for Africa.

3.1. Rationale for Enacting National Space Laws and the Evolution of Private Space Actors in Africa

Over the years, State actors have primarily dominated the space exploration scene, which is reflected in the overall outlook of the UN Space Treaties. However, with the growth of commercial industries here on Earth, the State dominated space scene has gradually experienced a shift in actors, with non-state actors extending their endeavors and technological advancements to space. By *Article VI of the Outer Space Treaty*, each State bears international responsibility for the national activities of its non-state actors in outer space. For this reason and the requirement for authorization and continuing supervision of the activities of non-governmental entities in outer space (provided for in *Article VI of the Outer Space Treaty*), States primarily regulate the activities of their private actors. States fulfill this authorization and continuing supervision requirement by enacting national space laws that lay down the provision for licensing and carrying out any launch or space-related activities by their private actors. The provision for regulating launch-related activities within and outside the territory of a State is critical because of the provision of *Article VII of the Outer Space Treaty,* by which

[136] African Space Strategy: Towards Social, Political and Economic Integration (2017), online (pdf): *African Union* <www.au.int/sites/default/files/newsevents/workingdocuments/33178-wd-african_space_strategy_-_st20445_e_original.pdf>

launching States bear liability for damages caused by their launch object and the component parts of their launch object.

States are faced with the potential risk of compensating other States or third parties for damage resulting from the space objects of their private space actors. Hence, to minimize the risks of paying compensation and indemnification against the private actor whose space object caused the damage, States generally regulate and control these activities.[137]

The innovative space endeavors of private space actors, over the years, give credence to the importance of commercial actors in advancing the space industry. The term NewSpace stems from the diverse space endeavors carried out by private space actors against the traditional dominance of state actors in space.

The NewSpace Africa Industry Report[138] extensively reviewed thirty-four private and public companies in the African space industry. Of the thirty-four companies reviewed, three are offshoots of university research institutions, the government owns five, and the remaining twenty-six are private companies. Twenty-one of these companies are situated in South Africa, four are in Nigeria, four are in Mauritius, and two are in Egypt. Kenya, Sudan, and Tunisia each host one of these space companies.

Seven African countries host private space companies, of which South Africa takes the lead. The products of many of these NewSpace companies in Africa serve the African market and the global market[139], thereby promoting economic investment in Africa. Hence, private actors play a crucial role in developing Africa's space economy. The African space industry is worth USD 7.37 billion, with a growth projection of over USD 10.29 billion within the next five years.[140]

The NewSpace sector in Africa is growing and fast-evolving. Africa will significantly benefit from supporting and investing in the space sector and developing indigenous capacity in space technologies and services. Therefore, it is imperative to examine the current legal regime for licensing private actors in the African States identified above and the governance structure for fostering Africa's space development.

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[137] Annette Froehlich & Vincent Seffinga, *National Space Legislation: A Comparative and Evaluative Analysis*, vol 15 (Switzerland: Springer International Publishing, 2018) at 11.

[138] "NewSpace Africa Industry Report" (2019), online: *Space in Africa* <www.africanews.space/download/6967>

[139] Ibid.

[140] Ibid.

3.1.1. *Licensing Requirement for Private Space Activities in Nigeria*

The National Space Research and Development Agency (NASDRA) Act of 2010[141] is the primary legislation regulating the activities of private space actors in Nigeria.

One of the functions of the Agency includes the implementation of strategies for promoting private sector participation in the space industry.[142] The National Space Council ('Council'), established for the Agency, has the power to "grant approval to the Agency to enter into research and production partnerships with any Company, Non-Governmental Organization, firm or individual."[143] This provision of the Act creates the opportunity to foster partnership between private space actors and NASDRA, and it should be explored to enhance private sector participation in Nigeria. On public-private partnerships in the United States, the National Aeronautics and Space Act[144], and the National Space Policy, 2010, makes provisions for NASA to partner with private/commercial space actors in the United States to advance the commercial space sector in the United States. NASA plays a dynamic role in establishing partnerships with commercial space actors in developing capacity and promoting the commercial space industry in the United States. Some examples of NASA's partnership with the commercial space sector include the partnership between NASA and the Hughes Corporation, executed through a contract between both parties to build Syncom to demonstrate synchronous orbit, station keeping on-orbit, and sizing of communication link performance in synchronous altitude.[145] The Commercial Orbital Transportation Services (COTS) is another example of NASA's partnership endeavors to promote the commercial space industry. Under COTS, NASA partners with commercial space actors like SpaceX and Boeing in developing innovative commercial cargo space transportation systems to Low-Earth Orbit (LEO). This partnership also aims to eliminate NASA's reliance on Russia for transporting astronauts and cargo to the International Space Station (ISS).[146]

Also, NASA promotes public-private partnerships through development awards like NASA's Tipping Point awards for companies to develop innovative space technologies. NASA has awarded tipping point awards worth over $120 million. Made in Space, a manufacturing company that was a recipient of the tipping point award is now testing its 3D-Printing

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[141] National Space Research and Development Agency Act, 2010, FGP 37/42011/1,500 (Vol. 97).
[142] Section 6(e), NASDRA Act.
[143] Section 7(b), NASDRA Act.
[144] The National Aeronautics and Space Act, 51 USC § 20112(a)(4).
[145] "Public-Private Partnerships for Space Capacity Development: Driving Economic Growth and NASA's Mission" (2014), online (pdf): *National Aeronautics and Space Administration* <www.nasa.gov/sites/default/files/files/NASA_Partnership_Report_LR_20140429.pdf>
[146] Ibid.

technology in space.[147] This sample project evidences the success of this award's advancement of public-private space partnerships in the United States.

In Nigeria, public-private space partnerships are mainly non-existent. There are few examples of successful public-private space partnerships in Nigeria, like the United States, which questions the provision of *Section 7(b) of the Act* in fostering public-private partnerships in practice. This provision appears to exist on paper without progressive implementation, highlighting a significant challenge with Nigeria's space sector development. One of the African Space policy objectives is promoting public-private partnerships for developing a novel indigenous and viable space industry in Africa.[148] This objective further stresses the importance of the private sector in the African space industry and the need for a synergy between the public and private sectors in driving technological advancement within the space sector in Africa.

The space governance framework in Africa needs to evolve towards promoting public-private partnerships beyond the mere letters of the law because the private sector plays a vital role in advancing technologies and building capacity for future space exploration endeavors in Africa. Hence, a country like Nigeria, for instance, on the strength of the provisions of *Section 7(b) of the NASDRA Act*, can seek to actively promote private sector participation in the space industry by creating enabling business environment for private space actors and supporting private space actors with seed funding or tax rebate. On licensing of private space actors, the NASDRA Act[149] empowers the Council on the recommendation of the Agency to grant a license to any person or body corporate for activities stated in *Section 6(k) of the Act*. Section 6(k) provides that "the Agency shall be the repository of all satellite data over Nigeria's territory and accordingly, all collaborations and consultation shall be carried out or undertaken by or with the Agency." This section appears to focus more on remote sensing activities and fails to provide for the licensing of space activities that fall outside the scope of remote sensing. Some other jurisdictions like the United States, Canada, and India have dedicated regulations on remote sensing activities. For example, the United States regulates remote sensing activities through its *U.S. Land Remote Sensing Policy Act*[150] and the *U.S. Regulations on Licensing of*

[147] Michael Sheetz "How NASA is Evolving through Partnerships with Private Space Companies" (2019), online: *CNBC Evolve* <www.cnbc.com/2019/11/30/how-nasa-is-evolving-through-partnerships-with-private-space-companies.html>

[148] "The African Space Policy: Towards Social, Political and Economic Integration" online (pdf): *The African Union Commission* <www.au.int/sites/default/files/documents/37433-doc-african_space_policy_isbn_electronic_.pdf>

[149] Section 9(1), NASDRA Act.

[150] United States of America Land Remote Sensing Policy Act (1992), 51 USC 6010.

Private Remote Sensing Space Systems[151]. Canada's remote sensing activities are governed by the *Remote Sensing Space Systems Act*[152] and the *Regulations*[153]. India regulates remote sensing activities through its *Remote Sensing Data Policy of 2011*, and India also currently has a *Draft Space-Based Remote Sensing Policy of India (2020).*

While remote sensing is an integral part of space activities and crucial for defense and national security, space activities transcend remote sensing activities alone. Therefore, it is crucial for the legal framework regulating space activities in Nigeria and the attendant licensing requirement to broadly consider space activities beyond remote sensing.

As Fras G. von der Dunk puts it, "while the NASDRA Act established the basic competence of the Agency to issue licenses as well as the general framework for compliance with the major international obligations of Nigeria, it still left more detailed questions in this regard unanswered."[154] The Act fails to provide a robust regulatory framework for present and future space endeavors.

The Act further lays down the conditions for granting a license in Nigeria, including public health, the safety of persons and property, consistency with Nigeria's international obligations, and national security.[155] On liability, the Act requires the licensee to be insured against liability arising from damage or loss suffered by third parties in Nigeria or elsewhere due to the licensee's activities as authorized by the license granted.[156] This provision is essential because States bear international responsibility for national activities in outer space, whether such activities are carried out by governmental agencies or non-governmental agencies – *Article VI of the Outer Space Treaty*.

As noted above, while the NASDRA Act aims to promote private sector participation in the development of space activities in Nigeria, there are still significant loopholes in the Act which need to be addressed by the Agency in conjunction with the Council and the legislative arm of the Nigerian government.

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[151] United States of America Regulations on Licensing of Private Remote Sensing Space Systems, (20 May 2020) 15CFR Part 960.

[152] Remote Sensing Space Systems Act, S.C. 2005, c. 45.

[153] Remote Sensing Space Systems Regulations, SOR/2007-66.

[154] Frans G. von der Dunk "The Second African National Space Law: The Nigerian NASDRA Act and the Draft Regulations on Licensing and Supervision" (2017), online (pdf): *University of Nebraska – Lincoln* <www.digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1092&context=spacelaw>

[155] Section 9(2-4), NASDRA Act.

[156] Section 9(4)(f), NASDRA Act.

3.1.2. *An Appraisal of the Nigerian National Space Policy*

The Nigerian National Space Policy, commissioned in 2000, is a 25-year road map for developing space science and technology in Nigeria through research and development, capacity building, and proper administration.[157] The National Space Policy is in its 21st year with less than five years to achieve space science and technology development in Nigeria. It is vital to assess the achievements of the Space Policy so far in highlighting the best alternatives for the nation's space development.

The vision of Nigeria's national space policy aims "to make Nigeria build indigenous competence in developing, designing and building appropriate hardware and software in space technology as an essential tool for its socio-economic development and enhancement of the quality of life of its people."[158] Nigeria's space policy has made some gains, particularly on developing six research centers in Nigeria focused on remote sensing, satellite technology development, geodesy and geodynamics, space transport and propulsion, basic space science and astronomy, and space science and technology. Also, Nigeria has so far, launched six satellites (NigeriaSat-1, NigComSat-1, NigeriaSat-2, NigeriaSat-X, NigComSat-1R and NigeriaEduSat-1)[159]. However, there remains an evident gap in the development of Nigeria's space industry, for which the space policy has made very minimal progress. The space sector in Nigeria cannot be said to have made great progress on space capacity development and harnessing space benefits for Nigeria's socio-economic development. One of the shortfalls of the space policy is its short-lived dream of establishing a full-capacity rocket launch facility in Nigeria. All that the country has at present is a rocket testing facility. Also, Nigeria's promise of launching her first astronaut in space by 2015 has remained only a dream for which the country has made a new commitment to send an astronaut to space by 2030.[160] If nothing remains undone in identifying the challenges to achieving Nigeria's space ambitions and implementation hindrances to the National Space Policy, Nigeria's space ambitions and space capacity development will at best remain only on paper and political score points.

In identifying the factors that have limited Nigeria's space sector development, Dr. Francis Chizea (Acting Director-General of NASDRA) noted that the funding of space programmes

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[157] "Nigeria to Revise its National Space Policy and Strategy", online: *Space in Africa* <www.africanews.space/nigeria-to-revise-its-national-space-policy-and-strategy/>

[158] "National Space Policy", online (pdf): *dawodu* <www.dawodu.com/space.pdf>

[159] "Nigeria's Space Policy is Years Behind Schedule but Has Some Notable Achievements" (2020), online: *Space in Africa* <www.africannews.space/nigerias-space-policy-is-years-behind-schedule-but-has-some-notable-achievements/>

[160] Ibid.

solely by the government hindered the development of Nigeria's space industry. Hence it is imperative for the private sector to partner with the government to achieve a robust space programme for Nigeria because space programmes globally are executed through public-private partnerships.[161] The shortcomings of Nigeria's Space Policy are not unknown to the government and stakeholders in the industry who have highlighted the importance of space to the nation's development. In taking steps to address the shortcomings of the current national Space Policy, the President of the Federal Republic of Nigeria directed the Minister of Science and Technology to prepare and submit to the Federal Executive Council a revised 25-year roadmap for the implementation of the National Space Policy.[162] While this can be a laudable step in achieving the ambitions of the space policy, it is crucial for stakeholders involved in revising the National Space Policy to engage industry experts, including researchers, to develop the revised 25-year roadmap for implementing the National Space Policy. Also, a 25-year roadmap may not be best for the nation at present, recognizing the pressing need for the nation's development in space science and technology. The initial 25-year roadmap did not make significant progress in the nation's technical space capacity development. Hence, a roadmap with a shorter timeline or perhaps the same 25-year timeline subject to periodic reviews might be best in driving the nation's space development. It is also vital for the review of the National Space Policy to be done in great detail and not a rush project with the main aim of influencing and expediting funding for the space agency in Nigeria.

3.1.3. *Licensing Requirement for Private Space Activities in South Africa*

The South African National Space Agency Act[163] established the South African National Space Agency and laid down the objectives of the Agency, including the objective to support the creation of an environment conducive to industrial development in space technology.[164] The Agency can execute an agreement with any person, government, or administration in achieving its objectives.[165] This provision promotes public-private partnership between the government and private space actors in South Africa. The Agency may also "acquire an interest in any

[161] "Nigeria: NASDRA Seeks Private Sector to Collaborate on Space Programmes" (2020), online: *News Agency of Nigeria* <www.worldstagenews.com/nigeria-nasdra-seeks-private-sector-to-collaborate-on-space-programmes/>

[162] Juliana Taiwo-Obalonye, "Buhari Directs Onu to Submit Revised 25-year Roadmap on National Space Policy to FEC", online: *The Sun* <www.sunnewsonline.com/buhari-directs-onu-to-submit-revised-25-year-roadmap-on-national-space-policy-to-fec/>

[163] South African National Space Agency Act 36 of 2008 (Gazette 33847 of 3 December 2010).

[164] Section 4(b), South African National Space Agency Act.

[165]Section 5(2)(a), South African National Space Agency Act.

company or other juristic person undertaking the development or exploitation of an invention or technological space innovation."[166] The Space Affairs Act of South Africa[167] lays down the requirements for obtaining a license for private space activities in South Africa. This section forbids anyone from carrying out any of the space activities listed in sub-paragraphs a-d of Section 11, except by a license issued by the South African Council for Space Affairs (the 'Council'). The activities requiring a license includes the following: any launch from the South African territory, any launch from another territory by or on behalf of a company incorporated or registered in South Africa, operation of a launch facility, participation of any company incorporated or registered in South Africa, in space activities which may affect the national interest or which involves obligations to the State in terms of international conventions, treaties or agreements entered into or ratified by South Africa, and any other space activities prescribed by the Minister. The conditions for issuing a license include meeting minimum safety standards determined by the Council, national interests, and international obligations of the Republic of South Africa.[168] The Council is required to furnish reasons for refusal of a license by writing to the applicant whose application has been refused.[169] Also, the Council must gather and maintain information regarding licenses following international conventions entered into or ratified by South Africa.[170]

The South Africa Space Affairs Act provides a much more detailed licensing requirement for private space actors and space activities in South Africa when compared with the skeletal provision of the NASDRA Act. The Act clearly States the space activities requiring a license and gives the Minister the power to prescribe other space or space-related activities that will require a license, thereby ensuring that future space activities are also regulated.

The Council also has the power to amend, suspend or revoke a license granted under the Act.[171] Notably, the Act[172] empowers the Minister to order the Council at any time to suspend or revoke a license issued by the Council if, *in the opinion of the Minister*, the licensed activity conflicts with the interests of the State. The space industry and space activities are very dynamic, and generally, States seek to balance private space activities against national

[166] Section 2(c)(ii), South African National Space Agency Act.
[167] Section 11, Space Affairs Act 84 of 1993 (Gazette 15096 of 3 September 1993).
[168] Section 11(2), Space Affairs Act.
[169] Section 11(3), Space Affairs Act.
[170] Section 11(4), Space Affairs Act.
[171] Section 13, Space Affairs Act.
[172] Section 13(7), Space Affairs Act.

interests. This particular sub-section appears to give the Minister extensive powers to balance national interest against licensed activities.

The Act[173] grants powers to the Council, with the concurrence of the Minister, to determine the liability of the licensee resulting from international conventions, treaties and agreements entered into or ratified by the Republic of South Africa. The license may include conditions relating to liability for damage and security given by the licensee for damages. Also, "the liability of a licensee remains in force in respect of claims resulting from activities related to the license concerned, irrespective of whether or not the license has been suspended or revoked."[174] This provision on liability is crucial because, as stated earlier, States bear international responsibility for the national activities of their governmental and non-governmental organizations in outer space.

However, the Act contains a limitation of liability clause which provides that "the State or anyone in the employment of the State, the Minister or the Council shall not be liable in respect of anything done under this Act in good faith and without negligence.[175]"

This section contradicts the provision of *Article VI of the Outer Space Treaty* above. This section also contradicts *Article II and III of the Liability Convention,* which respectively provides for the absolute and fault-based liability of a launching State for damage caused by its space object. There are several ways of making private actors responsible for damages caused by their space activities. The requirement for private space actors to be insured against damage resulting from their space activities in the NASDRA Act is a good example.

Also, while regulations are essential in promoting commercial space activities in Africa, member States must be intentional about public-private partnerships and create an enabling environment for private space business. NASA's space commercialization efforts are an excellent example for African States to promote space commercialization in Africa.

Private space actors should be viewed as partners in the progress of Africa's space endeavors and the African space value chain, and not as competitors. Space commercialization will foster indigenous launch capacity in Africa and open Africa to economic investments, which will develop Africa's space economy for the benefit of everyone.

[173] Section 14(1)(b), Space Affairs Act.
[174] Section 14(6), Space Affairs Act.
[175] Section 21, Space Affairs Act.

3.1.4. *A Robust National Space Policy: The South African Model*

South Africa's National Space Policy seeks to serve as a guide to all stakeholders in the South African space industry and to promote improved coordination and supportive governance in the space sector in South Africa. The guiding principle of the Policy is to support and promote scientific research, capacity-building, innovation, and industrial development, aimed at utilizing space applications to contribute to economic growth, poverty reduction, and knowledge creation.[176] The policy principles of the South African National Space Policy centers around supporting the Republic to use outer space for peaceful purposes and the benefit of humankind per *Article 1 of the Outer Space Treaty*. Other principles of the policy highlight the Republic's commitments in promoting research in space science and technology and enhancing the domestic space industry. One notable provision of the South African Space policy is its commitment to extending the benefits of space technology to Africa through partnerships with other African countries.[177] This provision is essential as most countries' space laws and policies focus on international and inter-agency partnerships. African States need more than international partnerships to develop indigenous space capacity. Member States in Africa need to support and partner with each other to achieve the goals of the African Union Agenda 2063. It is agreed that each country faces distinctive challenges that hamper its socio-economic development. However, the socio-economic development challenges faced by African States are quite similar. As such, partnership amongst African States will be instrumental in achieving space development on a larger scale in Africa.

The South African National Policy contains implementation guidelines to achieve the principles and objectives of the policy. Government departments and agencies implement the policy through co-operative governance, developing adequate space capabilities, strengthening the space science and technology base, fostering national space infrastructure, enhancing international cooperation, promoting a domestic space industry, and enhancing space awareness across the board. The space policy carefully notes the financial implications of developing space science and technology infrastructure. Hence, public sector investment needs to support space technologies that offer broad socio-economic benefits.

The Department of Trade and Industry is responsible for monitoring and evaluating the implementation of the South African National Space Policy every ten years or any time before

[176] "Republic of South Africa National Space Policy" (2008), online (pdf): *UNOOSA* <www.unoosa.org/documents/pdf/spacelaw/national/safrica/nat-policyE.pdf>
[177] Ibid.

as the Minister deems fit.[178] In contrast with the Nigerian Space Policy with a 25-year implementation plan, a 10-year implementation plan subject to review is a much better approach to ensure that the relevant agencies and stakeholders play their part in achieving the goals and objectives of the Space policy.

3.1.5. *Skeletal Regulatory Framework for Space: The Space Policy of the Federal Democratic Republic of Ethiopia*

Many countries have at least a national space law and a national space policy regulating space activities within their region. Several developed space-faring countries have taken further steps by enacting additional space regulations to regulate specific space endeavors like Remote Sensing, Telecommunication, etc. Unlike these space-faring developed countries, including some African countries with national space laws and space policy, Ethiopia uniquely does not have a national space law but only a National Space Policy.

Ethiopia's space policy aims to ensure Ethiopia's indigenous competence in space science and technology to meet the national development demands of the nation. Ethiopia's space policy recognizes that the Government is mindful of the challenges faced by the Ethiopian space program, for which it is determined to execute appropriate policy measures and strong leadership for accelerated development of the space industry and the Republic of Ethiopia.[179] Cognizance of the challenges facing the Ethiopian space program helps in drafting a policy geared towards addressing these challenges and meeting the needs of the people of Ethiopia. The policy further goes into the role and strategic leadership position that the Ethiopian Government will occupy in fostering progressive investment and support for the rapid development of Ethiopia's space industry.

In addition to developing infrastructures to support Ethiopia's space industry, the Ethiopian Government aims to generate revenue from space tourism and other services and provide diverse funding and incentive schemes.[180] This is a daring aspiration like the Kennedy declaration, and daring aspirations like this galvanize any nation's space industry. While it is not inherently bad for a space policy to be ambitious, what is made of the ambitions is of utmost importance. For example, following the Kennedy Declaration in the U.S., the budget followed, and necessary stakeholders played their role in achieving the Kennedy Declaration. However,

[178] Ibid.
[179] Federal Democratic Republic of Ethiopia Space Policy (2018).
[180] Ibid at 5.

there are daring declarations in many African countries without substantial implementation mechanisms. A space policy can have modest and aspirational objectives. However, implementation of the policy's objectives remains crucial.

Ethiopia's space policy implementation plans cut across strategic plans for space science research, human resource development programs in space science and technology, regulations for establishing resilient institutional frameworks, and financial support for private sector participation. As with other national space policies examined above, the implementation of Ethiopia's space policy is also guided by certain principles. Some of these principles include; space utilization for peaceful purposes and the benefit of humankind; promoting women and youth participation in the space sector; the Government taking a leading role in space science and technology development in Ethiopia; promoting partnerships, public and private sector participation in developing Ethiopia's space industry, and active participation in the implementation of the African space program.

Ethiopia's space policy takes a unique approach to drive space science and technology development to benefit the people of Ethiopia. Notably, the policy highlights the main challenges facing space science and technology development in Ethiopia. They include the lack of highly skilled experts, technical experts in designing and manufacturing satellites, absence of priority setting in research and alignment with national demand, inadequate scientific infrastructure, and weak collaboration between institutions working in the space domain.[181] Consequently, the foundations of the space policy are framed around strategic plans to solve these identified challenges for space science development to meet the national demands and needs of the people of Ethiopia. The policy provides a well-defined implementation framework with designated institutions and their role in driving the space policy implementation.

Although Ethiopia does not have a national space law regulating the space activities of their non-state actors, the space policy provides for space affairs regulation. This provision is, however, very skeletal in its form and nature. It emphasizes the government's mandate to the Ethiopian Space Science and Technology Institute (ESSTI) to "issue permits to persons desiring to engage in space activities, control their operations, register space objects, and regulate in collaboration with other relevant organs overall aerospace activities that emanates within and outside the country and operated in the country's jurisdiction."[182] The Policy's strategies for space affairs regulation aims to develop directives that clarify regulatory

[181] Ibid at 8, 10.
[182] Ibid at 15.

requirements on space objects and related activities. However, Ethiopia needs much more than a skeletal regulatory framework for space activities within the region and for regulating the activities of non-state actors within and outside Ethiopia. Through robust national space legislation, Ethiopia can provide adequate regulatory mechanisms for its non-governmental entities' activities, and fulfill its international obligations in the UN Space treaties, particularly the authorization and continuing supervision requirement in *Article VI of the Outer Space Treaty*. Also, through a dedicated national space law, the region can address liability issues arising from its non-governmental entities' activities.

Also, the regulation as per the space policy covers the overall *aerospace activities* emanating within and outside Ethiopia. The policy appears to somewhat fuse aviation and space activities regulation under the Ethiopian Space Science and Technology Institute (ESSTI). For the explicit purpose of regulating space activities, it is more beneficial for ESSTI to focus on regulating space activities while the appropriate aviation body regulates aviation activities within the region. While there are overlaps between both fields, particularly with the rapid development of space tourism, it will nonetheless be beneficial for ESSTI to focus on regulating space affairs in Ethiopia against infusing both fields for now. There is always room for the regulatory body of both fields to collaborate when the need arises. However, Ethiopia needs to focus on forming a solid regulatory framework for private actors, space exploration, and space science and technology development in the region.

3.2. Governance Structure for Africa's Space Development

Africa needs thorough and properly structured governance mechanisms for developing the African space industry and market. The lack of adequate infrastructure and governance structure poses a significant setback to Africa's socio-economic, space science, and technology development. Also, the various international programs and investments to support Africa's development will make minimal progress without a governance structure that fosters development.

Africa's development goals are embedded in the African Union Agenda 2063, which stems mainly from the United Nations Agenda 2030. In achieving the African Union Agenda 2063

and the United Nations Agenda 2030, suitable governance structures backed by national development strategies that align with these goals and aspirations are vital.[183]

Some of the fundamental challenges prohibiting good governance in Africa include but are not limited to corruption, weak democratic institutions, and limited access to crucial data for governance and development.[184] These challenges also hamper suitable governance structures for Africa's space sector development.

According to the International Finance Corporation, the lack of adequate infrastructure poses a significant setback to Africa's development and ability to harness and maximize its vast natural and human resources.[185] Another significant challenge to good governance in Africa is the lack of statistical capacity and data. For example, a densely populated country like Nigeria does not conduct periodic census exercises to provide accurate data on the country's citizens and residents, and this is not peculiar to Nigeria alone. Accurate data on population is also crucial for tax purposes, which will fund most governance activities and developmental projects for the benefit of all citizens.

The lack of statistical data poses a significant challenge with forming and assessing developmental policies. Accurate data, which is core to driving developmental policies in Africa, is not readily available and accessible.

Hence, these policies are formulated mainly based on estimates or the most accessible data.

In recognition of the importance of governance to Africa's development, the third aspiration of the African Union Agenda 2063 aims to strengthen the culture of good governance in Africa. The South African National Space Policy also highlighted the importance of coordination and cooperative governance as critical to optimize the benefits of space applications to society.[186]

There is a considerable lack of precise indicators for monitoring Africa's progress in achieving Agenda 2063. The lack of data for governance within Africa contributes to the challenges in evaluating Africa's progress towards achieving the UN SDGs and Agenda 2063.[187] Africa will benefit immensely from Agenda 2063 if the African Union establishes clear indicators for monitoring and assessing Africa's progress in achieving the Agenda. This is critical to the success of the Agenda and should be prioritized for action by the African Union.

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[183] Annette Froehlich, Nicolas Ringas & James Wilson, *Space Supporting Africa - Volume 3: Security, Peace, and Development through Efficient Governance Supported by Space Application*, vol 28 (Switzerland: Springer Nature, 2020) at 2.

[184] Ibid at 24.

[185] "Africa's Infrastructure Bottleneck" (2018), online: *The Infrastructure Consortium for Africa* <www.icaafrica.org/en/news-events/infrastructure-news/article/africas-infrastructure-bottleneck-587040/>

[186] South African National Space Policy, *Supra,* note 176.

[187] Ibid at 51.

The governance structure for development in many African countries has not improved over the years. The situation has only gotten worse with increased corruption, violence, and insecurity in some instances. Achieving a governance structure that supports development systems in Africa cannot be accomplished in a vacuum. The African Union must take a leadership role in supporting Member States to address the fundamental challenges prohibiting good governance in Africa because "the continued implementation of governance requires a complex framework of political institutions supported by administrative bodies at a continental, regional and national level."[188] The African Union can provide this framework in partnership with member States.

However, recognizing each Member State's independence to govern and manage its affairs, the AU may encounter some implementation challenges. Nevertheless, it will be beneficial for the African Union to work more closely and strategically with Member States if any progress is to be made in addressing the impediments to good governance in Africa.

In addition, a governance structure that embraces dialogue and considers the interests of relevant stakeholders will be beneficial to the African Space industry.

3.3. Comparative Analysis: Regulatory Framework for Space Activities in Asia - India and Indonesia as Case Studies

INDIA	INDONESIA
India is yet to enact a National space law or space policy regulating space activities in India.	The Indonesia Space Act (ISA)[189] broadly regulates Indonesia's space activities.
India has some policies regulating certain space activities like the India Space Policy on remote sensing and the policy on Satellite communication	The ISA aims to optimize space for the benefit of the people of Indonesia, ensure space sustainability for present and future generations, and provide a legal basis and certainty in space activities.[190]
India has a Draft Space Activities Bill, 2017	The ISA covers a broader range of space activities.[191] Also, the Act aligns with the provisions of the Outer Space Treaty

[188] Annette Froehlich, Nicolas Ringas & James Wilson, *Supra*, note 183 at 50.
[189] Law of the Republic of Indonesia Number 21 of 2013 on Outer Space, online: *HUKUMONLINE.COM* <www.hukumonline.com/pusatdata>
[190] Article 2, Indonesia Space Act.
[191] Article 6 &7, Indonesia Space Act.

	prohibiting the use of nuclear weapons or weapons of mass destruction in space.
Like many other national space laws, the Bill emphasizes liability due to damage by space objects.[192]	The Act places the responsibility for conducting annual space policy studies and recommendations for policy development on the Space Agency.[193]
The Bill misses out on legislating crucial aspects of India's international obligations like the rescue and return of astronauts, non-appropriation of outer space, and outer space exploration for the benefit of all humankind.[194]	The ISA provides for mitigating the re-entry of space objects and the search and rescue of astronauts.[195]
The Bill fails to include several vital obligations of the Indian space industry or lacks clarity while imposing such obligations.[196]	The Act also provides for the development of rocket technology, satellite technology, aeronautics technology, and spin-off technology.[197]
India needs a coherent national space law because of its evolving commercial space industry. Also, to adequately address liability issues and foster the fulfillment of international obligations.	The Act provides a 25-year master plan produced by the Space Agency for national guidelines to manage space endeavors. The master plan contains short, medium, and long-term strategic plans for space activities in Indonesia.[198]
The need for a legal framework that ensures certainty of the legal regime remains a crucial reason for India to implement a national space law.	The liability and compensation provision of the ISA is very similar to the provisions of the Liability Convention, including the Claims Commission and alternative dispute resolution provision in the Liability Convention.[199]

Although the OST does not explicitly mandate States to enact national laws or policies for regulating space activities, the decision to implement international treaties by bringing the obligations under the treaty into harmony with national laws provides a state with the rationale

[192] Upasana Dasgupta, "Do National Space Laws Look Beyond Liability For Damage? – The Case of India" (2019), online: *SSRN* <www.papers.ssrn.com/sol3/papers.cfm?abstract_id=3452925> at 2 and 5.
[193] Article 9, Indonesia Space Act.
[194] Upasana, *Supra*, note 192.
[195] Chapter VII, Article 58-70, Indonesia Space Act.
[196] Ibid.
[197] Article 24-32, Indonesia Space Act.
[198] Article 40, Indonesia Space Act.
[199] Chapter X, Article 76-83, Indonesia Space Act.

for enacting national laws that meet the nation's needs.[200] While India remains without a national space law, it also appears that the national space laws of many States, particularly African States, cover specific space activities while excluding others. For example, the NASDRA Act focuses majorly on regulating and issuing licenses for remote sensing-related activities, which remains one of the flaws and limitations of the Act. Can India be said to be demonstrating to the international community that the absence of a national space law does not in any way hinder space science and technology development in the region? And can Ethiopia be following the Indian model by having a national space policy alone?.

In many developed space-faring nations like the U.S. and Canada, their respective national space laws strive to cover all possible space activities, with other sector-specific laws or policies being enacted to govern specific space endeavors in the nation. This exemplifies a clear intention and effort to drive the fulfillment of their international space obligations through national laws and policies.

Unlike India, the ISA provides a very robust regulatory framework for space activities to ensure the implementation of Indonesia's international space obligations. The ISA provides an excellent national space law model for many countries, particularly African countries and other Asian nations.

3.4. Analysis of the Space Policy Implementation Framework in the United States of America and Canada: Any Lessons for Africa?

3.4.1. *The National Space Policy of the United States of America*

The National Space Policy of the United States is divided into five major segments - Introduction, Principles, Goals, Intersector Guidelines, and Sector Guidelines.

The Principles embody the tenets of the Outer Space Treaty, particularly on state responsibility and the peaceful use of outer space by all States and non-appropriation of outer space. The U.S. National Space Policy aims to achieve the following goals; develop innovative technologies, advance the development of space launch, satellite manufacturing, and increased entrepreneurship which strengthens the domestic space market of the United States. The Policy also aims to increase international cooperation to advance the peaceful use of outer space, bolster stability in space by protecting critical space systems, and support infrastructures and

[200] Ranjana Kaul & Ram S. Jakhu, *Supra*, note 134 at 157.

measures to mitigate orbital debris.[201] The Space Policy of the United States broadly supports both the national and international development of outer space endeavors. The Policy seeks to strengthen the domestic space commercial market in the United States and support structures and framework for international space exploration to maximize the benefits of space for all in line with the provision *of Article I of the Outer Space Treaty*.

The Intersector Guidelines of the U.S Space Policy contains a set of guidelines to support stakeholders in achieving the goals of the Policy. The intersector guidelines focus on strengthening the United States' leadership in space science and technology through research and innovation in the commercial space industry, particularly in developing efficient space launch systems. The intersector guidelines also aims to enhance the United States' leadership in space-based positioning, navigation, and timing systems. The guidelines make provision for developing and retaining space professionals by creating opportunities in the current space workforce. This includes public-private partnerships and investment in initiatives to attract and promote the education of individuals in STEM. The intersector guidelines also promote interagency partnership to boost the capacity of the United States to accomplish national goals, identify required outcomes, and advance implementation and response strategies.[202]

The Sector Guidelines provide a roadmap for the commercial, civil, and national security sectors through which the United States' space activities are conducted. The commercial space guidelines focus on promoting a sufficient commercial space industry by enhancing favorable regulatory/licensing requirements for commercial space actors, encouraging the sale and use of U.S. commercial space services in international agreements, and exporting U.S. developed space goods and services in foreign markets.[203]

The sector guidelines also center on achieving crewed missions in space, including the continued operation of the International Space Station (ISS), the development of advanced launch systems and technologies, and collaboration with other space-related agencies to maximize the benefits of space to meet the needs of humans. The National Security space guidelines develop space systems to support U.S national security, defense, and intelligence.[204]

The National Space Policy of the United States provides a much detailed and robust policy framework for advancing both the interests of the United States in space, the continuous development of the commercial space industry in the U.S., and the fulfillment of the

[201] "National Space Policy of the United States of America" (2010), online (pdf): *NASA* <www.history.nasa.gov/national_space_policy_6-28-10.pdf>

[202] Ibid at 6.

[203] Ibid at 11.

[204] Ibid at 13.

international obligations of the United States in the space sector. Developing and retaining space professionals in the United States space industry is a crucial provision that African States can adopt in developing or amending their national space policies constructively. African States need to encourage, support, and develop young African Space professionals who will, in turn, be able to make significant contributions to both the technical and legal development of space systems and programmes in Africa. Also, these young Africans will be able to represent their country by contributing to international conversations and negotiations that promote their country's interest in the international space community. While programmes and platforms like the African Leadership Congress foster young Africans' participation in conversations and research towards advancing the African space industry, provisions in the national space policy targeting the next generation of African space professionals remain crucial for Africa.

Also, strengthening inter-agency partnerships is another crucial provision African States can incorporate in their national space policies because partnerships are crucial to driving innovations and growth within any system. Only a system that promotes strong internal partnerships amongst national agencies can make the best of international partnerships. Chapter four of this research will examine the indigenous African concept of 'UBUNTU' and its application to driving strategic partnerships for increased space activities in Africa.

The U.S. National Space Policy also pays particular attention to advancing the commercial space sector in the United States through favorable regulatory policies and fostering the sale of commercial space products. As noted above, private space actors play a critical role in advancing the African space industry, and national policies supporting the commercial space industry in Africa will revolutionize and advance space systems in Africa.

3.4.2. *Canada's Space Policy Framework: Launching the Next Generation*

The Minister of Industry, Honorable James Moore, in his Foreword Message to Canada's Space Policy Framework, noted that Canada's Space Policy Framework focuses on delivering results. Also, the policy will generally lay the foundation to motivate the next generation to pursue science and engineering studies and related STEM professions.[205] As with the National Space Policy of the U.S., Canada's Space Policy Framework also seeks to motivate young Canadians to pursue careers in STEM.

[205] Canada's Space Policy Framework: Launching the Next Generation, online (pdf): *Canadian Space Agency* <www.asc-csa.gc.ca/pdf/eng/publications/space-policy/canadas-space-policy-framework.pdf>

Canada's Space Policy Framework introduces the importance of space and space services to Canada's national interests and the well-being of Canadians. Hence the need for government action in promoting the Canadian space sector and the domestic space industry through a guiding policy framework. Canada's Space Policy Framework is predicated on five core principles that the implementing areas of action seek to achieve. The five core principles that will influence Canada's space activities include; *prioritizing Canadian interests*, *positioning the private sector at the forefront of space activities*, *progress through partnerships*, *excellence in key abilities,* and *inspiring Canadians*.[206] These core principles focus on efficiently using space to protect Canada's national sovereignty and security. At the same time, the government supports the domestic commercialization of the Canadian space industry through innovative technologies. The policy also recognizes and highlights the importance of collaboration with international entities in maximizing the benefit of space for all parties. Unlike the National Space Policy of the United States, which approaches partnership in two dimensions to wit, inter-agency partnership and international partnerships, Canada's Space Policy Framework focuses on international partnerships.

Canada's Space Policy Framework further highlights Canada's established excellence in the international space sector and the need for the government to continuously support and expand Canada's established space competencies with a focus on novel space technologies.

Canada's Space Policy implementation framework will be achieved through four primary areas of action; Commercialization, Research, and Development, Space Exploration, Stewardship, Management, and Accountability. On commercialization, the Canadian government will support the private sector in various ways, including negotiating international agreements for open access opportunities for Canadian businesses. In addition to the several ways in which any government can support its private sector, international market access is very crucial to the success of several industries, particularly the space industry. This provision in the Canadian Space Policy is essential for market growth, and it is a vital provision that African States can adopt to support private actors in Africa.

Canada's approach to achieving the core principles of its space policy through research and development strategy aims to leverage existing expertise and programs for the technological development of Canada's areas of proven strength like robotics, optics, satellite communications, and space-based radar.[207] On space exploration, the government of Canada

[206] Ibid at 8.
[207] Ibid at 11.

is committed to continuing Canada's Astronaut Program to develop the indigenous capacity of Canadians to participate in present and future space endeavors and position Canada as a desirable partner in the international space community.

Finally, the government will establish a Canadian Space Advisory Council representing public and private space industry stakeholders and a Committee to review objectives and expenditures.

The Canadian Space Policy is very tailored to leverage the experience and expertise of the Canadian space sector as an industry leader while supporting the commercial space industry in harnessing space to meet the needs of Canadians. Canada's Space Strategy[208] contains similar goals and aspirations to the Canadian Space Policy Framework and will not be examined separately.

Both the U.S. and Canadian space policies focus on constructively supporting their private actors and promoting the education of individuals in STEM by developing and retaining space professionals and creating opportunities in the space sector. These are two crucial aspects to developing a nation's space capacity and industry. It will be beneficial for African States to carefully adopt the U.S. and Canadian models in this regard, taking into account the unique nature of Africa. Also, breaking down policies into sector guidelines like the U.S. will help achieve the objectives of Africa's space policies.

3.5. Domestic Procedures for Implementing International Space Obligations in Africa

The Outer Space Treaty (OST) embodies major principles of international space law that States are bound to comply with in the conduct of their space endeavors. These international space law principles constitute the most general rules of behavior for States in their space endeavors.[209]

The table below compares the various provisions of the domestic space laws of Nigeria, South Africa, and Ethiopia towards fulfilling these international space obligations.

[208] Exploration, Imagination, Innovation: A New Space Strategy for Canada(2019), online (pdf): *Canadian Space Agency* <www.asc-csa.gc.ca/pdf/eng/publications/space-strategy-for-canada.pdf>

[209] Gennady Zhukov & Yuri Kolosov, *International Space Law*, 2nd ed. stereotyped, translated by Boris Belitzky (Moscow, Russia: CTATYT, 2014).

PRINCIPLE/ OBLIGATION	NIGERIA	SOUTH AFRICA	ETHIOPIA
Article I OST: *Freedom of Exploration and Use of Outer Space*	The Agency shall develop national strategies for exploiting outer space.[210]	The Council may advance matters leading to the orderly and responsible use of outer space.[211]	Ethiopia is committed to utilizing outer space for peaceful purposes and the benefit of all humankind.[212]
Article II OST: *Non-appropriation Principle*	NIL	NIL	NIL
Article III OST: *Space exploration in accordance with International Law and the UN Charter*	License to private actors is issued on the condition that the activities licensed is consistent with the international obligations of Nigeria[213] and avoidance of any breach of Nigeria's international obligations[214]	The Council may supervise and implement space affairs arising from international conventions, treaties and agreements ratified by South Africa;[215] and also issue, amend, suspend or revoke licenses granted for private space activities[216] taking into account the international obligations and responsibilities of South Africa.[217]	NIL
Article IV OST: *Non-weaponization / demilitarization of outer space*	NIL	South Africa is committed to utilizing space for peaceful purposes.[218]	Ethiopia is committed to utilizing outer space for peaceful purposes.[219]
Article I and II Rescue and Return	NIL	NIL	NIL

[210] Article 6(e), NASDRA Act, 2010.
[211] Article 3(g), Space Affairs Act, 1993.
[212] Article 3.7(1), Ethiopia Space Policy, 2018.
[213] Article 9(2)(b), NADSRA Act, 2010.
[214] Article 9(4)(f)(iii), NASDRA Act, 2010.
[215] Section 3(c), Space Affairs Act, 1993.
[216] Article 3(d), Space Affairs Act, 1993.
[217] Article 11(2)(c), Space Affairs Act, 1993.
[218] National Space Policy of South Africa, 2008.
[219] Article 3.7(1), Ethiopia Space Policy, 2018.

Agreement & Article V OST: *Rescue and Return of Astronauts and Space objects*			
Article VI OST: *State responsibility for national space activities*	Private activities are regulated through the grant of a license.[220]	Private activities are regulated through the grant of a license.[221]	The Ethiopian Space Science and Technology Institute issues permit to private actors.[222]
Article II Liability Convention & Article VII OST: *Liability of launching States*	Licensees are required to obtain insurance covering liability for damage or loss suffered by third parties due to the licensed activities.[223]	License conditions may include security to be given by the licensee for damages and liability arising from international conventions, treaties, and agreements ratified by South Africa.[224] The liability of a licensee on claims arising from the license remains in force whether the license is suspended or revoked.[225] South Africa has a limitation of liability clause protecting the State and its employees from liability for anything done under the Act in good faith and without negligence.[226]	NIL
Article II Registration Convention &	The Agency must maintain a register	NIL	The Ethiopian Space Science and Technology Institute

[220] Article 9, NASDRA Act.
[221] Article 11, Space Affairs Act, 1993.
[222] Article 4.5.1, Ethiopia Space Policy, 2018.
[223] Article 9(4)(f), NASDRA Act.
[224] Article 14(1)(a)(b); Article 14(2)(a-c), Space Affairs Act.
[225] Article 14(6), Space Affairs Act.
[226] Article 21, Space Affairs Act.

Article VIII OST: *Registration of space objects*	of space objects.[227] The register shall contain particulars of such objects as the Agency considers appropriate to comply with Nigeria's international obligations.[228] A licensee may be required to provide the Council with information about its space object, launch details, including orbital parameters.[229]		is mandated to register space objects.[230]
Article IX OST: *Avoiding harmful contamination of Outer Space, the Moon, and celestial bodies and adverse change to Earth*	The license issued to a private actor may include conditions requiring the licensee to conduct operations in a way that prevents the contamination of outer space or cause adverse changes to Earth.[231]	NIL	NIL
Article IX OST: *Principle of Co-operation and Mutual Assistance*	NIL	NIL	The Principles of the Ethiopian Space Policy includes promoting co-operation with other nations in mutually beneficial and peaceful uses of outer space.[232]
Article IX OST: *Principle of Due Regard*	A licensee in Nigeria shall avoid interference with the	NIL	NIL

[227] Article 10, NASDRA Act.
[228] Article 10(2), NASDRA Act, 2010.
[229] Article 9(4), NASRDA Act, 2010.
[230] Article 4.5.1 Ethiopia Space Policy.
[231] Article 9(4)(f)(i), NASDRA Act.
[232] Article 3.7(7), Ethiopian Space Policy, 2018.

	activities of others involved in the peaceful exploration of outer space.[233]		
Article XI OST: *Notification to the UN Secretary-General on the nature, conduct, location, and result of space activities.*	No specific requirement in the NASDRA Act. However, Nigeria has three functional space objects registered with the UN-Secretary General.[234]	The Council shall gather, maintain and disseminate information regarding licenses following applicable international conventions, treaties and agreements.[235] South Africa has four functional space objects registered with the UN Secretary-General.[236]	No specific requirement in the Ethiopia Space Policy. However, Ethiopia has one functional space object registered with the UN-Secretary General.[237]
Assistance to spacecraft personnel in accident, distress, or emergency landing	NIL	NIL	NIL

Table 3.5.1.[238]

[233] Article 9(4)(f)(ii), NASDRA Act.
[234] "Notifications from States and Organizations: Nigeria", online: *UNOOSA* <www.unoosa.org/oosa/en/spaceobjectregister/submissions/nigeria.html>
[235] Article 11(4), Space Affairs Act, 1993.
[236] "Notifications from States and Organizations: South Africa", online: *UNOOSA* <www.unoosa.org/oosa/en/spaceobjectregister/submissions/southafrica.html>
[237] "Notifications from States and Organizations: Ethiopia", online: *UNOOSA* <www.unoosa.org/oosa/en/spaceobjectregister/submissions/ethiopia.html>
[238] NIL in the table above means the national space law of the country is silent on the national means of implementing the particular principle/obligation.

3.6. CONCLUSION

National space laws and policies play a crucial role in charting the roadmap for actualizing a country's national space goals and ambitions. Space laws are also vital in providing the framework for the domestic implementation of a country's international obligations.

While the major space players in Africa have enacted national space laws and policies to set the path for space activities in their country, several African States are yet to prioritize the domestication of national space laws and policies.

The table above shows that the domestic space laws and policies of the African States assessed fail to adequately domesticate the procedure for fulfilling some of their international space obligations.

National space laws and policies help identify the priorities, and main objectives of a Country's space endeavors, thereby creating further transparency, coordination among decision-makers, and security for private actors.[239] Hence, it is crucial for any nation to take active steps to participate in the international space community and harness the benefits of space for its citizens to pay attention to enacting national space laws and policies to stimulate, direct, and govern its national space endeavors.

The SANSA Act empowers the Agency to execute partnership agreements with any entity to achieve its objectives. In Nigeria, the NASDRA Act empowers the National Space Council to grant approval to the Agency to enter into research and production partnerships. This might occasion some bureaucratic roadblocks for the Agency and delay the execution of certain partnership agreements. It will be beneficial for Nigeria to adopt the South African model of directly empowering the Agency to execute partnership agreements with any entity for achieving its objectives.

Also, in South Africa, the Council must furnish an applicant with reasons for refusal of the applicant's license. This provision is forward-thinking as it would be helpful to applicants to understand the reasons for any rejection and re-structure their application accordingly. This section preserves the transparency of the licensing process in South Africa, and other African countries should incorporate this provision in their national space laws.

Although there are lessons that African States can learn from the space policy and implementation framework of countries like the United States and Canada, as highlighted above. However, African States yet to enact their national space law can take a cue from other

[239] Magda Cocco & Helena Correia, "Formulating Space Policies and Laws for Development and Growth in African Countries" (2019), online: *Space in Africa* <www.africanews.space/formulating-space-policies-and-laws-for-development-and-growth-in-african-countries/>

African States like Nigeria and South Africa. Even though the space-faring African States still have a long way to go in developing indigenous space capacity and amending its national space law and policy with feasible implementation plans and structures, there is still so much that the passive space users in Africa can learn from their space-faring counterparts. It is also essential for countries like Nigeria and South Africa to take intentional steps and leadership roles in supporting the other African States to develop their capacity to maximize space technologies and their benefits.

Although laws and policies are crucial to Africa's space sector development, political will and economic support remain vital in achieving Africa's space ambitions. Hence, Chapter four of this work will look into Africa's space sector development from an economic perspective.

CHAPTER IV

AFRICA's SPACE SECTOR DEVELOPMENT: THE INTERSECTION OF LAW AND ECONOMICS

4.0. Introduction

Laws and policies are in themselves not sufficient to achieve Africa's space ambitions. Neither are they solely sufficient to enhance Africa's capacity to leverage space technologies for its socio-economic development. Hence, in taking a holistic approach to this research, this chapter will assess Africa's space development from an economic perspective, particularly the intersection of law and economics. This is important because the African space sector will not achieve much progress without the appropriate means for financing space development projects in Africa.

This chapter will examine the role of two key leaders: the African Union and the African Development Bank in advancing Africa's space sector. This chapter will also make a comparative analysis of the space budgets of Nigeria, South Africa, and Ethiopia in the last three years[240], in identifying the financial priority that each country has given to its space sector development.

Furthermore, an overview of Africa's satellite launch activities will be examined in evaluating the role of law in enhancing Africa's launch capacity and fostering strategic space partnerships in Africa.

The national space laws of Nigeria, South Africa, and Ethiopia will also be assessed in identifying how these countries fulfill their international obligation to register their space objects.

In promoting space commercialization in Africa, it is also crucial for Africa to support the sale and purchase of satellite data within the region in boosting economic investments in Africa's space sector. Therefore, this chapter will also assess the legal framework for incentivizing satellite data commercialization in Africa.

[240] Due to the limited availability of data accessible at the time of this work, this research is only able to compare the space budgets of Nigeria, South Africa and Ethiopia in the last three years being 2018-2020.

4.1. Assessing the Role of the African Union in the Development of Africa's Space Sector

The African Union is a crucial leader that plays a vital role in advancing continent-wide development for the benefit of Member States and Africa as a whole. As such, the African Union plays a vital role in advancing Africa's space sector development.

In assessing the role of the African Union as a leader in propelling Africa's space sector development, it is crucial to examine the organizational structure of the AU, including its decision-making and implementation framework. Understanding this structure will help assess the AU's role at present and means to expand or improve the work of the AU in promoting and enhancing the development of Africa's space sector.

The organizational structure, decision-making and implementation framework of the AU is detailed in **ANNEX - 1** of this research.

4.1.1. *The Space Development Framework within the African Union – The African Union Agenda 2063, the African Space Policy, and the African Space Strategy*

The African Union Agenda 2063 is a 50-year inclusive growth and development framework for Africa, executed from national to regional and continental levels.[241] Agenda 2063 is a strategic plan for Africa's long-term socio-economic and integrative transformation towards achieving the Pan African vision of an integrated, prosperous and peaceful Africa.[242]

In collaboration with NEPAD Planning and Coordinating Agency (NPCA), the African Development Bank and the United Nations Economic Commission for Africa (UNECA), the African Union developed Agenda 2063.[243] "Agenda 2063 has been undertaken and coordinated in the Office of the Chairperson of the AU Commission, under the Directorate of Strategic Policy Planning, Monitoring, Evaluation and Resource Mobilization (SPPMERM)."[244]

The process for developing Agenda 2063 included technical work involving consultations and analytical work. The consultations involved the opinions from Africans, government officials of member states, youth, women, media groups, Regional Economic Communities (RECs), and organs of the AU. The analytical work assessed the national plans of member states and

[241] "Agenda 2063: The Africa We Want" (2015), online (pdf): *African Union Commission* <www.au.int/sites/default/files/documents/33126-doc-01_background_note.pdf> at 2.
[242] "About the African Union", online: *African Union* <www.au.int/en/overview>
[243] "01 Background Note – Agenda 2016: The Africa We Want" (2015), online (pdf): *African Union Commission* <www.au.int/sites/default/files/documents/33126-doc-01_background_note.pdf>
[244] Ibid.

the former and present agendas of RECs and the AU in all sectors.[245] Afterward, the draft Agenda 2063 Framework Document and the First Ten-Year Implementation Plan were prepared and adopted by the policy organs of the AU. The Framework Document contains the vision for Agenda 2063, the transformation framework, and the implementation strategy.[246] The implementation of Agenda 2063 will be undertaken at three levels, from national to continental. The national level (Member States) will be responsible for implementing critical activities, while the regional level (Regional Economic Communities (RECs)) will implement the monitoring and evaluation framework at the regional level. At the continental level, the AU organs will undertake extensive monitoring and evaluation based on contributions from the RECs.[247] Member States and the RECs are required to adopt Agenda 2063 alongside its Ten Year Implementation Plans as the basis for developing their national and regional visions and plans, respectively.[248]

Member States are expected to play a crucial role in developing policy guidelines to structure the implementation, monitoring, and evaluation of Agenda 2063.[249] This is vital because each Member State is in the best position to ensure the national implementation of Agenda 2063. The actions taken by each State towards implementing this Agenda will collectively help achieve the aspiration of the Agenda towards the 'Africa we Want.'

The development of the technical capacity of Member States to maximize the benefits of space exploration for Africa's socio-economic development is one of the prioritized flagship projects in the execution of Agenda 2063. Following the need for Member States to promote policies for implementing Agenda 2063's aspirations, space capacity development in Africa is best achieved through the strategic actions taken by each Member State. These strategic actions include creating institutions and structures that support the technical space capacity development of the younger generation and private sector participation in outer space activities. Agenda 2063 has promising aspirations. Implementing these aspirations (particularly on space capacity development) will propel Africa's socio-economic development, reduce Africa's intensive reliance on international programs, and enhance Africa's participation in the global space community as prominent and equal partners.

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[245] Ibid.
[246] Ibid.
[247] Ibid.
[248] "11 An Overview of Agenda 2063 – Agenda 2063: The Africa We Want" (2015), online (pdf): *African Union Commission* <www.au.int/sites/default/files/documents/33126-doc-11_an_overview_of_agenda.pdf>
[249] Agenda 2063, *Supra*, note 241 at 14.

Noting that Africa cannot outsource the technological developments needed to solve its socio-economic development, the African Space Strategy aims to advance an indigenous space sector and guide the African Space Programme.[250] The African Space Policy goals focus on creating a well-coordinated African space programme responsive to Africa's socio-economic, political, and environmental needs. The Policy also aims to develop a regulatory framework to support the African space programme towards ensuring Africa's responsible and peaceful use of outer space.[251] Each African State needs to play a more active role in developing indigenous space capacity within their region. The African Space Strategy also notes that active participation in the development of space-related applications and services will enable Africa to address its socio-economic development challenges, achieve the objectives of the African Union Agenda 2063, and make a substantial contribution to the implementation of the Science, Technology, and Innovation Strategy for Africa.[252]

While the African Space Policy and Strategy documents highlight the importance of space to solving Africa's socio-economic development challenges and the need for Africa to build indigenous space capacity, the Policy and Strategy documents have not fully been implemented. This lack of full implementation of the Agenda is reflected in the Continent's overall space capabilities at present.

While African States are encouraged to work towards implementing Agenda 2063, it is not far-fetched that most Member States with national space policies will prioritize the implementation of their national policies in achieving the set goals of their space policies. However, because the African Space Policy and Strategy document contain similar goals to that of the national space policies of Member States, implementing a country's national space policy will contribute to the implementation of the African Space Policy.

Also, stakeholders at all levels, including Member States must use the results framework provided in the Ten-Year Plan for implementing Agenda 2063 in monitoring and evaluating the execution of its responsibility and goals of Agenda 2063.[253] This framework is significant in keeping all stakeholders accountable for playing their part in implementing Agenda 2063.

In addition, the African Union Commission will organize annual consultations between the Organs of the AU and the RECs on the implementation, monitoring, and evaluation of Agenda 2063.[254]

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[250] African Space Strategy, *Supra*, note 136.
[251] Ibid at 9.
[252] African Space Strategy, *Supra*, note 136 at 4.
[253] 01 Background Note, *Supra*, note 243 at 14.
[254] 11 An Overview of Agenda 2063, *Supra*, note 248.

4.2. Financing Africa's Space Sector: The African Development Bank (AfDB) and the African Union as Key Actors

Space financing is crucial to achieving space development in Africa as lack of funding has been a significant factor in delaying the implementation of many developmental projects in Africa, including space projects. This is evident in the roadblock encountered in progressing with the execution of the African Space Agency due to lack of funding.

Hence, in examining this issue of funding, it is vital to assess the role of the AU and the African Development Bank (AfDB), the key Bank of the Continent, in financing Africa's space sector development.

In assessing the role of the AfDB, **ANNEX – 2** of this research details the organizational structure of the Bank, its decision-making and implementation mechanisms, including the Bank's financing framework, project implementation and evaluation procedures.

The Agreement establishing the AfDB[255] clearly states that, in implementing its purpose, the bank shall prioritize the financing of investment projects and programmes which concern several members; and projects designed to increase the economy of its members, including an expansion of their foreign trade.[256] These priority areas and the project's potential contribution to the purpose of the Bank guide the Bank in selecting suitable projects for financing.[257] Space programs and projects fall within these two priority areas in the Agreement and should, therefore, be prioritized by the Bank.

The AU African Space Strategy highlights the importance of sufficient funding to guarantee the excellent development and long-term sustainability of space activities in Africa. The strategy document further notes that funding for space initiatives should be sourced from within Africa through African governments, the private sector, and philanthropists.[258] The Strategy document does not precisely consider the AfDB as a potential financier of space projects in Africa.

Also, looking at the operational priorities of AfDB's Strategy, the operational priorities include infrastructure development, regional economic integration, private sector development, governance and accountability, skills, and technology. In implementing the AfDB's ten-year

[255] Agreement Establishing the African Development Bank, signed on the fourth day of August 1963, in Khartoum, Sudan by 23 African Governments, and entered into force on the 10th day of September 1964 following the subscription of twenty member countries to 65% of the initial authorized capital stock.
[256] Article 2(1)(a)(i-ii), Agreement Establishing the African Development Bank.
[257] Article 17(ii), Agreement establishing the AfDB.
[258] African Space Strategy, *Supra*, note 136 at 16.

strategy, the Bank focuses on fragile states, agriculture, food security, and gender.[259] It appears that space is not a central or specific priority area for the AfDB even though space projects and programs can be said to be within the purview of projects to be prioritized for financing by the Bank as in *Article 2(1)(a)(i-ii) of the Agreement Establishing the AfDB* above.

The AU Space Strategy, which focuses on Africa's space sector development, indicates that the strategy is aligned to reflect Africa's *aspirations*.[260] Also, the AfDB's Strategy for 2013-2022 (which does not explicitly prioritize Africa's space sector development) indicates that the strategy "reflects the *aspirations* of the entire African Continent."[261] This evidences some disconnect and goes to question what precisely the aspirations of the African Continent are.

As examined and noted in the first chapter of this work, space technologies are crucial to solving Africa's socio-economic development challenges, including agriculture and food security which is one of the three areas of particular emphasis for AfDB's strategy implementation. The importance of space to Africa's development cannot be over-emphasized. While it can be argued that space projects are within the purview of the other operational priorities of the AfDB, this research proposes that Africa's space sector development be included as a distinct priority area of the AfDB. Also, a clear framework for financing space projects should be developed in partnership with the African Union. This is vital to support private space actors in Africa and support the space projects and endeavors of African countries. Since the current strategy cycle of the AfDB comes to an end in 2022, the Bank needs to engage stakeholders in developing the framework for space financing within the Bank. A space financing framework within the AfDB will be crucial to achieving the internal continent funding option proposed by the AU African Space Strategy to promote an African-led space programme.

Also, the African Union is working towards establishing continental financial institutions like the African Central Bank, the African Investment Bank, and the African Monetary Fund.[262] Since space is within the priority areas of the AU, it will be beneficial to Africa if one or a combination of these continental financial institutions develop a clear space financing framework towards achieving the goals of the African Union Space Strategy and the AU Agenda 2063.

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[259] "AfDB's Strategy for 2013-2022", online: *AfDB* <www.afdb.org/en/about-us/mission-strategy/afdbs strategy>

[260] African Space Strategy, *Supra*, note 136 at 3.

[261] Ibid.

[262] "About the African Union", *Supra*, note 242.

In developing an Africa-led space programme, the AU should refrain from encouraging the culture of Africa's extensive dependence on gratuitous donations from international partners and donor countries. Instead, the AU, in partnership with organizations like the AfDB, should encourage African countries, support them and help guarantee private funding for their space projects and programs. Through this, the AU and the AfDB, as key industry leaders, will fulfill their leadership role and duty of supporting Member States to achieve the 'Africa we Want.'

4.3. The Space Budgets of Nigeria, South Africa and Ethiopia (2018-2020): Comparative Analysis

Charity begins at home. Therefore, in addition to the role of other stakeholders in supporting the space sector development of African countries, each county needs to show its commitment to the development of its space sector. The financial allocation a nation makes to its space industry through its national budget is critical evidence of its commitment to developing its space sector. Hence, this research will undertake a comparative analysis of Nigeria, South Africa, and Ethiopia's space budgets in the last three years to assess the priority given by each country to its space industry.

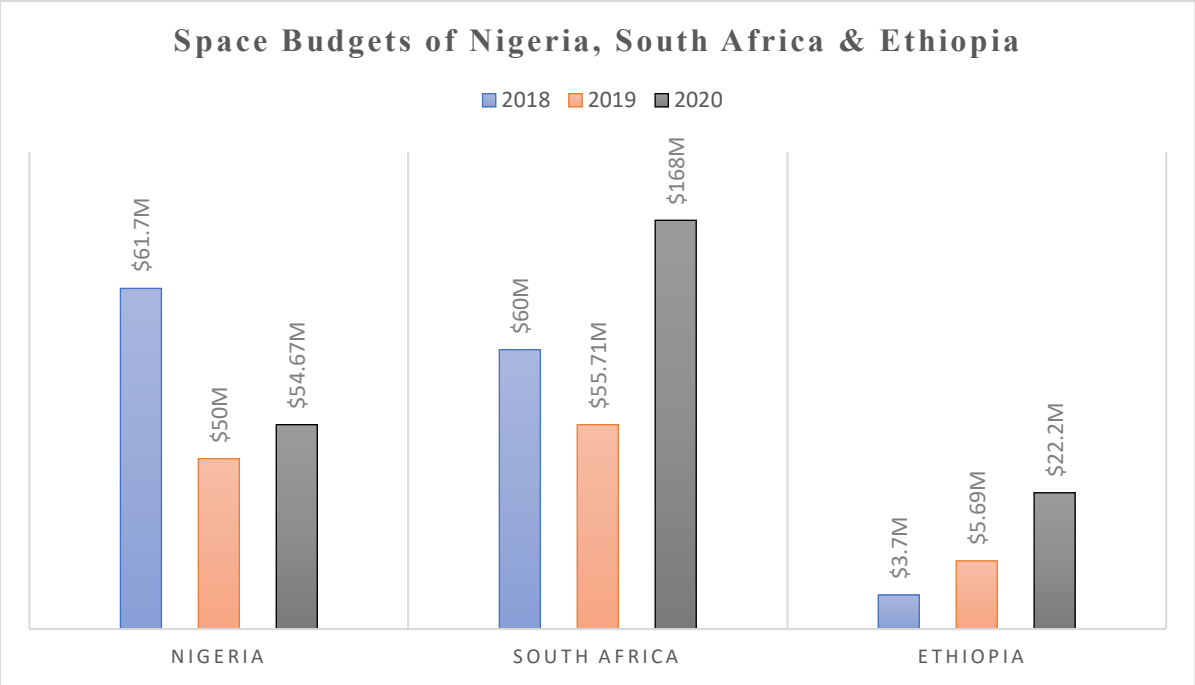

Figure 4.3.1

From figure 4.3.1 above, Nigeria and South Africa's space budgets decreased in 2019. The decrease in Nigeria's 2019 space budget is due to the devaluation of the Naira as the allocation

to the space Agency itself was not reduced.[263] Nigeria's space budget is shared between NASDRA and its regional centers, the Nigerian Communications Satellite Limited and the Defense Space Administration.

Nigeria's space budget from 2018-2020 does not evidence heavy financial investment in its space sector. As one of the space-faring nations in Africa, Nigeria needs to prioritize its space sector development by allocating substantially adequate funds that will support space projects within the region. Also, by allocating sufficient funding to its space sector, Nigeria evidences its willingness to develop this crucial sector.

Compared to Nigeria, South Africa's space budget progressively increased in 2020, thereby aligning South Africa's space development ambitions with its financial allocation.

Ethiopia appears to allocate funds for its space sector at an almost steady pace. Acknowledging that Ethiopia has not been in the space scene for as long as countries like Nigeria and South Africa have been, it is not far-fetched that Ethiopia's space budget is considerably lower than that of Nigeria and South Africa. However, with time, Ethiopia's space budget will be expected to increase as it continually prioritizes its space sector development.

Despite the fluctuating figures in the above table, the space budget of Africa's space industry has grown steadily and positively. Africa's space budget rose from USD 283.12 million in 2018 to USD 325.11 million in 2019, further increasing to USD 503.12 million in 2020. In 2021, Africa's space budget increased by 9% over the 2020 budget, to USD 548.6 million.[264] The continent's space budget, on average, is rising progressively. However, with further support from institutions like the AfDB and the AU, many African Countries will be able to access funding for varied space projects which will support Africa in harnessing space technologies and space resources for Africa's socio-economic development. This will also boost economic investments in Africa's space industry and Africa's economy as a whole.

[263] "Global Space Budgets: A Country-Level Analysis" (2021), online (pdf): *Space in Africa* <www.spaceinafrica.com/wp-content/uploads/2021/07/Global-Space-Budget.pdf> at 15.

[264] "African Space Industry Revenue to Surpass USD 10.24 Billion by 2024 Despite COVID-19 Setback" (2021), online: *Space in Africa* <www.africannews.space/african-space-industry-revenue-to-surpass-usd-10-24-billion-by-2024-despite-covid-19-setback/>

4.4. Reviewing the Scorecard: An Overview of Africa's Launch Activities

From 1989 till date,[265] African countries have launched forty-four satellites. Thirteen African countries launched forty-one out of the forty-four satellites, and the remaining three satellites were launched as a multilateral project involving several African countries.[266]

There are one hundred and fourteen new satellites currently being developed by twenty African countries and expected to be launched in the next five years. Thirteen African countries have launched a satellite in space, and ten countries are developing their first satellite.[267]

Nigeria has launched six satellites: Nigeriasat – 1 was launched in 2003, the NIGCOMSAT1 launched in 2007, the NigeriaSat – 2, the NigeriaSat – X, and the NIGCOMSAT 1R were launched in 2011. In 2017, the NigeriaEduSAT – 1 was launched.[268]

South Africa has launched eight satellites: SUNSAT was launched in 1999, ZACUBE launched in 2003, SUMBANDILA launched in 2009, KONDORE launched in 2014, nSight1 and ZA-AEROSAT were launched in 2017, Zacube launched in 2018, and XinaBox ThinSAT launched in 2019.[269]

Ethiopia has launched two satellites: ETRSS -1 was launched in 2019, and ER-SMART – RSS was launched in 2020.[270]

Egypt is leading the satellite launch scene in Africa, having launched nine satellites. South Africa comes close with eight satellites launched. Nigeria and Algeria have launched six satellites each while Morocco launched three satellites, and Ethiopia launched two satellites. Angola, Ghana, Kenya, Mauritius, Rwanda, Sudan, and Tunisia have launched one satellite each.[271]

4.4.1 *Beyond the Satellite Launch Race in Africa*

Space resources are scarce, and generally, satellite launch projects are very capital intensive. Consequently, satellite launch activities must not be viewed as a prowess contest among African countries. Instead, African States should approach their launch activities with a significant focus on the socio-economic benefits that can be derived from each launch activity by optimizing data from their satellites for their region's development.

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[265] Till date means 1st January 2020 when the data source of this research was published.
[266] "African Satellites" (2020), online: *Space in Africa* <www.africannews.space/african-satellites/>
[267] African Space Industry Revenue, *Supra*, note 264.
[268] African Satellites, *Supra*, note 266.
[269] Ibid.
[270] Ibid.
[271] Ibid.

Nigeria is a member of the International Disaster Monitoring Constellation, providing disaster-related imagery for free through its satellites in space. However, Nigeria generates income from its satellites by selling other image data. Nigeria's communication satellite, NigComSat-1R satellite, provides broadcast and internet services in Nigeria.[272] NigComSat-1R has offered crucial support for civil, commercial, and military demands in Nigeria.

Nigeria's NigComSat-1R and her earth observation satellite, NigeriaSat-2, are currently in operation. Although NigeriaSat-2 is surviving beyond its estimated life expectancy of seven years (2011-2018), it is not improbable that some of its critical components may not endure much longer, thereby halting the operation of the satellite.[273] Nigeria obtains data on security, agriculture, and transportation from NigeriaSat-2. Hence, if NigeriaSat-2 is not replaced before its final expiration, it will affect Nigeria's capacity to access space support for development, transport, and security.[274] An important satellite like NigeriaSat-2, should not be allowed to go down without adequate replacement plans because the data derived from this satellite is vital in addressing some of Nigeria's socio-economic development challenges. Also, as a responsible user of outer space, Nigeria must take proper steps to de-orbit its expired satellite. The final expiration of NigeriaSat-2 implies that Nigeria will be forced to rely on data from its archive or purchase data from foreign governments and private companies.[275] This will be costly to the country and amount to the underutilization of the financial resources expended in the launch of NigeriaSat-2 without adequate replacement plans. Also, reliance on foreign governments and private companies for critical data for the country's development and security is unsustainable and risky.

While Nigeria has considerably invested in its satellite launch activities and benefited from these satellites, Nigeria's space capabilities are still generally underutilized, and the available benefits from its satellite launch are not fully exploited. For example, data from Nigeria's earth observation satellites are not used in effective town planning in many parts of the country.[276] Also, considering the amount of data that can be derived from its earth observation satellites, the state of insecurity in Nigeria has only gotten worse over the years. Likewise, the flooding

[272] Jacob Aron, "How Nigeria has been Using its Satellites" (2013), online: *NewScientist* <www.newscientist.com/article/dn24025-how-nigeria-has-been-using-its-satellites/>

[273] Samuel Oyewole, "One of Nigeria's Satellites is on its Last Legs: Why is this Worrying" (2021), online: *The Conversation* <www.theconversation.com/one-of-nigerias-satellites-is-on-its-last-legs-why-this-is-worrying-165068>

[274] Ibid.

[275] Ibid.

[276] Ibid.

issue in major Nigerian cities like Lagos keeps getting worse with seldom flood warnings and an almost ineffective disaster management system in the region.

South Africa is home to the highest number of private space companies in Africa. Dragonfly Aerospace, a South African company, provides satellite imaging systems and is currently working on launching its own constellation.[277]

Following the worst civil unrest and mass destruction of properties experienced in South Africa in July 2021, the South African Space Agency (SANSA) "provided satellite images to support the government's efforts in assessing the geographic locations and scale of damage. The data also helped the government with scenario planning for future disasters (man-made or natural) in terms of identifying where to potentially deploy security forces, relief operations and activities to mitigate the risk of damage to infrastructure in the two provinces."[278] In protecting its coastlines, South Africa uses satellites to track marine activities along its coastlines, and the country has successfully tracked rouge ships.[279]

Ethiopia's remote sensing satellite, ETRSS-1 satellite, has provided vital data for applications across different sectors, including agriculture, infrastructure monitoring, water resource monitoring, and flood monitoring. Also, the ground station system has received 850GB of satellite data and produced 970GB standard product, which has aided the decision-making process in various sectors of the country.[280] Ethiopia cannot be said to have fully harnessed the potentials of its satellites, particularly for monitoring weather for improved agriculture planning, drought early earning and forestry management, mining, environmental protection, and earth observation purposes.[281] However, Ethiopia is still at an early stage in its space ambitions, and its satellites have not been in space for so long. It is hoped that the country will take full advantage of the benefits of its satellites in space.

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[277] Stephanie Bailey "Why Africa is Sending More Satellites into Space" (2021), online: *CNN Business* <www.cnn.com/2021/09/21/business/african-satellites-spc-intl/index.html>

[278] "#RebuildSA with a Little Help from Space" (2021), online: *SANSA* <www.sansa.org.za/2021/08/20/rebuildsa-with-a-little-help-from-space/>

[279] Jacqueline Feldscher "South Africa Leveraging Space to Solve Problems on Earth" (2019), online: *POLITICO* <www.politico.com/news/2019/11/01/south-africa-space-063031>

[280] "Ethiopia's First Satellite, ETRSS-1, has Been Operating in Orbit for 17 Months" (2021), online: *Space in Africa* <www.africanews.space/ethiopias-first-satellite-etrss-1-has-been-operating-in-orbit-for-17-months/>

[281] Abdur Rahman Alfa Shaban "Ethiopia's Historic Space Satellite, ET-RSS1: All You Need to Know" (2019), online: *Africanews* <www.africanews.com/2019/12/19/ethiopia-s-historic-space-satellites-et-rss1-all-you-need-to-know//>

4.5. Legal Requirement for the Registration of Satellites in Nigeria, South Africa & Ethiopia

The Registration Convention[282] provides the guideline for the registration of space objects by each launching state. *Article II of the Registration Convention*[283] specifies the requirement to register objects launched into earth orbit or beyond. Each launching state must maintain a registry in which it shall enter information on its space objects launched. Also, each launching state must inform the Secretary-General of the United Nations of the establishment of the registry. *Article IV of the Registration Convention* further lists the information to be furnished to the UN Secretary-General by each state of registry.

The Registration Convention provisions are also crucial because of *Article VIII of the Outer Space Treaty*, which vests the jurisdiction and control over a space object and any personnel thereof on the State of registry. Hence each State needs to make provision in its national space law guiding the registration of its space objects launched in outer space.

In fulfilling this international obligation to register and maintain a register of its space objects, the NASDRA Act of Nigeria empowers its space Agency to maintain a register of space objects. A copy of the register may be inspected by anyone on payment of the prescribed fees.[284] However, the Act fails to spell out the information to be entered in the register. Instead, the Act vaguely provides that "there shall be entered in the register particulars of such objects as the Agency considers appropriate to comply with the international obligations of the Federal Republic of Nigeria."[285] Nigeria has three functional space objects registered with the UN Secretary-General in fulfillment of its international obligation to notify the UN Secretary-General on its launched space objects.[286]

The Space Affairs Act of South Africa and the South African National Space Agency Act makes no express provision on the national legal procedure for registering space objects launched in South Africa or by a South African entity. South Africa ratified the Registration Convention in 2009 and is bound by the provisions of this Convention. However, South Africa occupies a unique position because it is the only African country to have notified the UN[287] of its establishment of a National Registry of Objects Launched into Outer Space. The focal point

[282] *Supra*, note 133.
[283] Ibid.
[284] NASDRA Act, Section 10(1)(3).
[285] NASDRA Act, Section 10(2).
[286] *Supra*, note 234.
[287] "Convention on Registration of Objects Launched Into Outer Space: Index of Notifications by Member States and Organizations on the Establishment of National Registries of Objects Launched into Outer Space", online: *UNOOSA* <www.unoosa.org/oosa/en/spaceobjectregister/national-registries/index.html>

of the national registry is the South African Council for Space Affairs, established by the Space Affairs Act of South Africa.[288] South Africa operates an online open-access registry with details on its launched space objects.[289] Also, from the UNOOSA Registry on notifications from States and Organizations, South Africa has four functional space objects registered with the UN Secretary-General.[290] The Space Affairs Act of South Africa also makes provision for penalties for anyone who contravenes the conditions of a license, performs any regulated space activities without a license, or fails to furnish the Council with relevant information or withholds, misrepresents, or provides false information concerning the license.[291] Such persons are guilty of an offence and liable on conviction to a fine not exceeding R 1,000,000 or to imprisonment for a period not exceeding ten years or both.[292]

The Ethiopian Space Policy reiterates the mandate of the Ethiopian government to the Ethiopian Space Science and Technology Institute (ESSTI), which includes the registration of space objects.[293] The Policy appears to reiterate the government's mandate to ESSTI but does not make any detailed provision regarding the registration of its space objects. The policy highlights that the main challenge regarding this mandate is the "lack of implementation practice due to the absence of detailed directives, standards and codes of conduct,"[294] which the policy will address. The policy will also put in place a space affairs regulatory environment. Ethiopia's space policy merely indicates its aim to establish a well-functioning regulatory environment for the notification, registration, licensing, renewal, inspection, and control of space and space-related affairs and strategies for achieving same.[295] Ethiopia's space policy lacks an adequate regulatory framework for regulating its national and private space endeavors and providing guidance on the domestic implementation of its international space obligations. However, in fulfilling its international obligation to inform the UN Secretary-General of its launched space objects, Ethiopia has one functional space object registered with the UN Secretary-General.[296]

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[288] Information Furnished in Conformity with the Convention on Registration of Objects Launched into Outer Space: Note Verbale Dated 11 July 2021 from the Permanent Mission of South Africa to the United Nations (Vienna) addressed to the Secretary General, UNCOPUOS, UN Doc ST/SG/SER.E/INF.27 (2012).

[289] "National Registry of Objects Launched into Outer Space", online: *The South African Council for Space Affairs* <www.sacsa.gov.za/registry/>

[290] *Supra*, note 236.

[291] Section 23, Space Affairs Act, South Africa.

[292] Ibid.

[293] Ethiopia Space Policy, 4.5.1.

[294] Ibid.

[295] Ethiopia Space Policy, 4.5.3.

[296] *Supra*, note 237.

4.6. The Role of Law and 'UBUNTU' in Enhancing Africa's Launch Capacity and Impelling Strategic Space Partnerships in Africa

While some African States have launched a number of satellites in the last three decades, none of these satellites were launched based on the sole competence of any African country. Africa has relied on the expertise of foreign partners in executing their launch, evidencing the lack of indigenous capacity in Africa to develop and launch satellites. For example, while Nigeria has trained many engineers, the country has not invested much in satellite manufacturing capacity and lacks the required infrastructure to support the manufacturing of satellites.[297]

While foreign partnerships are vital to developing indigenous space capacity in Africa, there is a need for the continent to look inwards and gradually seek less reliance on foreign support. Instead, Africa should make expedient use of foreign training and skill development opportunities to develop its indigenous space capacity.

In achieving this, the law plays a crucial role in propelling African countries to undertake this inward retrospect in developing Africa's indigenous launch capacity. The national space laws of the African countries assessed in chapter three of this work make provisions for private sector participation in one way or the other. However, the laws and policies fail to make a robust provision for supporting and developing indigenous launch capacity within their regions. African States need progressive laws that evoke the gradual development of their indigenous space capacity with less reliance on foreign support. For example, laws and policies, alongside adequate financial support and political will supporting foreign training for its youths and technical space professionals to develop the relevant skills for satellite manufacturing and launch, will progressively develop each country's indigenous space capacity.

Some African states have more advanced space capacities than others and should support and partner with the other African States to develop their space programs and capacities. The concept of 'UBUNTU' is arguably applicable in promoting intra-African space partnerships. UBUNTU is an African philosophy that emphasizes 'being self through others.' It is a form of humanism expressed in the phrase 'I am because of who we all are.'[298] In the spirit of enhancing and promoting indigenous space capacity across Africa, the African States with advanced space capacity should not view their space capacity as some power that places them ahead or generally better than other African countries. Instead, the goal should be to develop a continent-

[297] Samuel Oyewole, *Supra*, note 273.

[298] Jacob Mugumbate & Andrew Nyanguru, "Exploring African Philosophy: The Value of Ubuntu in Social Work" (2013) 3:1 AJSW at 82.

wide space capacity for Africans and Africa's development. This can only be achieved if African countries work closely together in enhancing their collective indigenous space capacity.

African has recognized the strength in intra-African partnership for the adequate exploration of space resources for Africa's benefit. This is, for example, evident in the re-igniting of the Pan-African Satellite constellation project known as the African Resource Management Constellation (ARMC). The ARMC aims to survey Africa in identifying its resources, including vegetation, farmland, and water.[299] This project is an excellent example of partnership between African States in using satellites to address significant socio-economic development challenges in Africa. Partner countries of the ARMC project (Algeria, Kenya, Nigeria, and South Africa) will launch one satellite each, forming a constellation of four Earth observation satellites in space with the same payloads, providing coverage and data for the management of Africa's resources.[300]

The law remains a guide and propelling force to members of the society, particularly on the framework and strategies for achieving development within the society. For this reason, African countries must engage experts and stakeholders in embracing viable laws and policies, alongside adequate implementation structure for expanding existing space partnerships in Africa and promoting intra-African space partnerships in addition to exploring foreign partnerships when expedient.

4.7. Legal Framework for Incentivizing Satellite Data Commercialization in Africa

The commercialization of satellite data is crucial to generating income and promoting economic investments in the African space sector. Currently, the continent lacks an adequate legal framework for incentivizing the sale of satellite data within Africa. Most African countries buy satellite data from foreign countries when African States have satellites in space that can produce some of these data bought abroad. The satellite data market is vastly untapped in Africa, and this needs to change for Africa to harness the economic benefits of satellite data commercialization. It is expensive to launch satellites in space. The commercialization of satellite data remains crucial to making some returns on the capital investments expended in

[299] "Pan-African Satellite Constellation in the Works" (2019), online: *South African National Space Agency* <www.sansa.org.za/2019/08/13/pan-african-satellite-constellation-in-the-works>

[300] "Four African Countries Reignite Plan to Launch Pan-African Satellite Constellation" (2019), online: *Space in Africa* <www.africannews.space/four-african-countries-reignite-plan-to-launch-pan-african-satellite-constellation/>

the launch of these satellites. It is imperative for each country with satellites in space to explore means of getting vital data from its satellites to solve its socio-economic development challenges and promote the commercialization of its satellite data as much as possible.

Also, in promoting the African space market, African countries are encouraged to purchase satellite data from other African countries before looking abroad to buy satellite data.

In addition to contacting the relevant country to purchase satellite data in Africa, the AU can also be a good contact point through which foreign countries can access member states to buy satellite data from Africa.

The legal framework for satellite data commercialization in Africa must progressively encourage the local purchase of satellite data through various incentives like a reduced market price for African countries, technical space capacity support to African countries that purchase satellite data, tax rebates, among other incentives. In addition, African countries can jointly operate a satellite data bank under the auspices of the AU. This satellite data bank should be operated under the auspices of the AU to have a central system managed by the topmost leadership body in Africa which both African and foreign countries can access.

In regulating the operation of the satellite data bank, a legal framework to be drafted by the AU, with contributions from all Member States, is vital. The legal framework for the satellite data bank must address various issues like the procedure for depositing satellite data, ownership of the satellite data, access to satellite data, and procedure for purchasing satellite data, transfer, and use of satellite data.

This satellite data bank should provide open access to specific satellite data and restricted access to satellite data for purchase. The satellite data provided can remain the property of the country providing the data, and the country can also specify any rules around the use of the data when necessary. This satellite data bank not only makes it easy for both African and foreign countries to purchase satellite data in Africa, but it also provides a central access point for satellite data in Africa under the auspices of the AU.

CHAPTER V

ON THE JOURNEY TO SPACE & SOCIO-ECONOMIC DEVELOPMENT IN AFRICA: WHAT DOES AFRICA OWE ITSELF?

5.0. Summary, Conclusion & Recommendations

Undoubtedly, Africa is the leading actor on its journey towards continent-wide development and self-sustainability in exploiting space technologies for its socio-economic development.

In achieving space capacity growth for Africa's socio-economic development, it is critical for all stakeholders in the value chain to play their part. Some stakeholders in Africa's space and socio-economic development value chain include governments, policymakers, regional institutions, NGOs, private entities and social enterprises, and young Africans.

On the progressive development of Nigeria's space industry, Adigun Ade Abiodun noted that: redirecting and restructuring Nigeria's space journey requires vision, talent, relevant skill set, and "essential financial resources that will come from a committed diversified economy that is not overwhelmingly dependent on the extraction of carbon deposits; and the unalloyed commitment of the government and the people of the country."[301] This is not only true for Nigeria, but it is also applicable to all African countries desirous of progressing their space sector to solve its socio-economic development challenges.

First and foremost, Africa owes itself to play a very dynamic and active role in developing its space industry, including executing strategic partnerships for space development. This research reiterates that Africa will never attain self-sustainability and space capacity development by continually relying on foreign help and aid at all times. While foreign support is vital, what Africa learns to do for itself will better sustain the continent towards achieving self-sustainability and socio-economic development.

The first chapter of this work established the rationale for this research by examining how space technologies are expedient for solving various socio-economic development challenges in Africa, such as agriculture and food security, climate change, security, and disaster management.

After establishing this rationale, chapter two assessed various international programs supporting Africa in leveraging space technologies for Africa's socio-economic development.

[301] Adigun Ade Abiodun, *Nigeria's Space Journey: Understanding its Past, Reshaping its Future* (Abuja: African Space Foundation, 2017) at 353.

This assessment revealed that while some of these programs have made some progress in Africa, there is still so much that Africa needs to do for itself in achieving socio-economic development using space technologies. Likewise, chapter two highlighted the danger in Africa's incessant reliance on international programs and support. Not only is this practice largely unsustainable, but it also promotes a mediocre mentality within the continent and hampers on indigenous space capacity development. Also, due to the crucial security and defense component of space endeavors and the access to data from space technologies, Africa will benefit more from developing indigenous space capacity and reducing its reliance on the international space community.

Chapter three of this work examined the legal and governance framework for space development in Africa, focusing on the role of law in promoting Africa's space development, including the provisions for enhancing private sector participation in the domestic space laws and policy of Nigeria, South Africa, and Ethiopia. The progress and shortcomings of the laws and policies of each country in fostering private sector participation and fulfilling its international space obligations were assessed.

Chapter three further analyzed the legal space framework in India and Indonesia in identifying any similarities or differences between the space law regime of the African countries assessed and any lessons that can be learned. India's unique position on space development without a unified national space law was of great interest, especially when compared with a country like Ethiopia with only a space policy as opposed to a national space law like other countries.

Also, the space policies of the United States and Canada were compared in identifying any lessons for Africa. One thing that stood out of the space policies of both countries is their commitment to supporting and developing their private space sector and, importantly, grooming and providing resources for the next generation to actively undertake STEM-related courses and pursue a career in STEM for the advancement of their space industry.

In developing Africa's space sector, each African country needs to prioritize the development of its younger generation in STEM. This next-generation support includes providing technical support in schools by incorporating relevant STEM courses in the school curriculum and providing relevant work opportunities for these young talents within Africa's space sector. In achieving this, schools in Africa with relevant space science and engineering courses and faculty can partner to implement exchange programs within Africa. This partnership can also be extended to schools abroad. Students of African descent can participate in STEM-related exchange programs abroad to broaden their knowledge in this field and develop their skillset to promote space technology development back in their home country.

With the understanding that the appropriate laws and governance framework still require adequate funding to bring space development projects to light, Chapter four examined the intersection of law and economics for Africa's space development. This chapter examined the role of the African Union and the African Development Bank in supporting and financing space projects in Africa. Having identified that space is not precisely one of the operational priorities of AfDB's strategy, this research recommends that the AfDB includes space in its operational priorities going forward as space plays a crucial role in Africa's development. Prioritizing space within the operational priorities of the Bank will go a long way in supporting space development projects and achieving the development aspirations of the continent, which both the AU and the AfDB aim to achieve.

Chapter four also assessed the indigenous African concept of 'UBUNTU' and the role of law in impelling strategic space partnerships in Africa, including the legal framework for incentivizing satellite data commercialization. This research proposed a satellite data bank in Africa under the auspices of the AU and a legal framework regulating the operation of the satellite data bank.

Existing space partnership agreements like the African Resource Management Constellation data-sharing agreement will also benefit from this proposed satellite data bank. The data-sharing agreement of the ARMC seeks to eliminate the restrictions occasioned by relying on non-African countries for satellite imagery not focused on the specific requirements of the continent.[302]

However, some prominent concerns with satellite data commercialization centers around privacy, data protection, and copyright issues. Who owns the right to the respective satellite imagery? What rights are transferred to the purchaser of a satellite imagery? What happens in the event of an infringement of the copyright of any State concerning its satellite imagery?

These are questions best addressed by the law. Due to the nature of rights attached to satellite imagery, this research proposes that the country with exclusive rights to its satellite imagery (the seller) be in charge of executing individual contracts with purchasers of satellite imagery. The contract should be explicit on the nature and extent of rights transferred to the purchaser by the sale. In addition, it will be helpful for each country to make provisions in its national law on the status, control, and use of acquired space data. For example, in the United States, the Commercial Space Act regulates the acquisition of space science data. Space science data

[302] Annette Froehlich, *Integrated Space for African Society: Legal and Policy Implementation of Space in African Countries* (Switzerland: Springer Nature, 2019) at 100.

must be acquired in accordance with applicable acquisition laws and regulations. Also, space science data is classified as a commercial item in the United States.[303]

After carefully reviewing the national space laws and policies of Nigeria, South Africa, and Ethiopia, assessing how these countries fulfill their international space obligations through their national space laws, a few issues and shortcomings of these laws are worthy of note.

In Nigeria, the NASDRA Act lacks a comprehensive definition section. The Act appears to focus more on defining terms relating to the Agency and the functions of the Agency[304] instead of defining relevant terms relating to space activities within the purview of the Act's regulation. Also, the NASDRA Act's provision on licensing of space activities restrictively focuses on remote sensing activities. The Act empowers the Council to grant anyone or corporation a license for activities stated in *Section 6(k) of the Act*.[305]

Section 6(k) of the Act provides that the Agency shall "be the repository of all satellite data over Nigeria's territory…"[306] Space activities transcend remote sensing activities. This provision of the NASDRA Act is very restrictive and suggests that it is majorly remote sensing activities that fall within the NASDRA Act for regulation. This provision of the Act must be amended for Nigeria to broadly regulate the varied space activities that can be carried out within its territory and by its nationals outside its territory. As a signatory to the Outer Space Treaty, Nigeria will bear international responsibility for the activities of its non-state actors in outer space.

Another shortcoming of the NASDRA Act is its lack of a provision on offences and sanctions/penalties. The Act is silent on the consequences for contravening the conditions of a license or the Act's provisions in general. Could the Nigerian government be counting on its non-state actors/licensees to act in good faith? The NASDRA Act should be amended classifying offenses punishable under the Act, the punishment for contravening the conditions of a license or the provisions of the Act.

The NASDRA Act is also silent on the revocation or transfer of license. In the commercial space industry, the transfer of license is not far-fetched. There are several reasons a licensee may desire to transfer its license, for example, change of ownership, merger, or acquisition of a company. Hence, the Act needs to make provisions on the procedure for transferring a license.

[303] Sec. 105, Commercial Space Act of 1998, 42 USC 14713.
[304] Article 36, NASDRA Act, 2010.
[305] Section 9(1), NASDRA Act, 2010.
[306] Section 6(k), NASDRA Act, 2010.

Also, if a licensee is acting in contravention to the license terms, the Agency should have the power to revoke the license.

Furthermore, the provision on registration of space objects in the NASDRA Act does not adequately provide the particulars to be entered in the register. The Act vaguely provides that "there shall be entered in the register particulars of such objects as the Agency considers appropriate to comply with Nigeria's international obligations."[307] It will benefit private actors to know what particulars they will be required to provide to the Agency for the space objects register. This provision should not be vague and relatively discretionary. The Act is also silent on property rights in space and the non-weaponization/demilitarization of outer space.

While the National Center for Remote Sensing, Jos, Plateau State, can go into satellite data acquisition, archiving, and distribution, the NASDRA Act is generally silent on the transfer, disposal, and use of dual-purpose technologies. In fulfilling its international obligation on the non-weaponization of space, the NASDRA Act must regulate dual-purpose technologies and non-state actors operating these type of technologies to avoid a contravention of this critical obligation.

This research recommends that Nigeria formulates and implements a separate Act solely focused on regulating space affairs instead of one Act that creates and regulates the Agency and the functions of the Agency while attempting to also regulate space affairs.

Although South Africa's domestic space laws address some of the inadequacies of the NASDRA Act, South Africa's national space laws are not without their limitations.

South Africa's space laws and Ethiopia's Space Policy are silent on avoiding the contamination of space and adverse change to the Earth resulting from the activities of its licensees. The Act fails to cover this vital consideration on the environment in fulfilling its obligation in *Article IX of the Outer Space Treaty.*

The Space Affairs Act of South Africa includes a limitation of liability clause, which states that "the State or any person in the employment of the State, the Minister or the Council shall not be liable in respect of anything done under this Act in good faith and without negligence."[308] This provision may be adequate if it seeks to limit the liability of the State for administrative issues resulting from the Act. However, if otherwise, South Africa's attempt to limit its international responsibility and liability in the Outer Space Treaty and the Liability Convention by its national law might be insufficient.South Africa will benefit more from

[307] Section 10(2), NASDRA Act, 2010.
[308] Section 21, Space Affairs Act

incorporating mandatory insurance provisions for their private space actors, including recourse actions to limit the liability of the Republic.

As with Nigeria, South Africa's space laws are also silent on the in-orbit transfer of space objects. The laws must provide the procedure for in-orbit transfer and notification of the Agency. This information will help the Agency in updating the space objects register and also notifying the UN-Secretary General on details of the space object.

Although South Africa is the only African country at present to have notified the UN Secretary-General of the launch of its national space registry, its national laws make no provision on the registration of space objects and are silent on the space registry. South Africa needs to update its national space laws to address these legal issues.

Ethiopia's space policy significantly lacks the adequate framework for regulating space activities in the region. The Space policy focuses on the limitations of Ethiopia in exploiting space tools and resources for the benefit of its citizens and the way forward. The Policy fails to make provisions on crucial issues like the liability of licensees or conditions for grant of a license.

The Policy lacks a detailed regulatory regime for space activities in the region. Hence, Ethiopia is encouraged to enact a national space law that focuses mainly on regulating space activities and fulfilling its international space obligations.

Notably, the space laws and policies of the States assessed make no provision relating to the rescue and return of astronauts and assistance to spacecraft personnel in accident, distress, or emergency landing. These obligations are also essential and should be covered by the national laws of African States.

In conclusion, why should we care about space when we have critical problems on earth?

Many Africans view Africa's space programs and ambitions as a waste of limited resources by making a case for prioritizing other sectors like agriculture, education, health, among others. Contrary to this popular opinion, our life on Earth is increasingly aided by space resources, and space technologies can solve Africa's socio-economic development challenges.

Consequently, African States will benefit greatly from strengthening their respective national legal framework to enhance the use of space technologies to solve their socio-economic development challenges and fulfill their international space obligations. Also, transparency on the part of government and stakeholders on space projects and the benefits derived from these projects will further strengthen Africa's space industry development.

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ANNEX - 1

A.1.1. Organizational Structure of the African Union, Decision-Making and Implementation Framework

Following the decision of the Organization of African Unity (OAU) in September 1999 to create a new continental organization to build on its work, the African Union was officially launched in July 2002.[309] The 55 member States of Africa make up the African Union. The African Union is guided by the vision of "An Integrated, Prosperous and Peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena."[310]

The objectives of the African Union are enshrined in the Constitutive Act of the African Union[311] and the Protocol on Amendments to the Constitutive Act[312]; some of which include: to accelerate the political and socio-economic integration of the continent; promote democratic principles and institutions, popular participation and good governance; establish the necessary conditions which enable the continent to play its rightful role in the global economy and international negotiations; advance the development of the continent by promoting research in all fields, in particular science and technology[313], amongst others.

The work of the AU is implemented through several principal decision-making organs. The organs of the AU include the Assembly of the Union; the Executive Council; the Pan-African Parliament; the Court of Justice; the Commission; the Permanent Representatives Committee; the Specialized Technical Committees; the Economic, Social and Cultural Council and the Financial Institutions.[314]

The Assembly, composed of the Heads of States and Government, is the supreme organ of the AU, and the Assembly meets at least once a year in ordinary session.[315] At the request of any Member State and on approval of two-thirds majority of Member States, the Assembly shall meet in extraordinary session.[316] The Assembly determines the structure, functions, and

[309] "About the African Union", online: *African Union* <www.au.int/en/overview>
[310] Ibid.
[311] The Constitutive Act of the African Union was adopted by the Thirty-Sixth Ordinary Session of the Assembly of Heads of States and Government on 11 July 2000 in Lomé, Togo.
[312] Article 1 of the Protocol on Amendments to the Constitutive Act was adopted in Maputo, Mozambique on 11 July 2003.
[313] Article 3, Constitutive Act of the African Union.
[314] Article 5, Constitutive Act of the African Union.
[315] Article 6(1-3), Constitutive Act of the African Union.
[316] Article 6(3), Constitutive Act of the African Union.

regulations of the Commission of the Union.[317] The Assembly also determines the functions, powers, composition, and organization of the Economic, Social, and Cultural Council.[318]

The decision of the Assembly and the Executive Council is by consensus or by a two-thirds majority of the Member States where consensus fails. Procedural matters, including whether an issue is one of procedure or not, are decided by a simple majority. The quorum for any Assembly and Executive Council meeting is formed by two-thirds of the total membership of the Union.[319] The Assembly and the Executive Council adopt their own Rules of Procedure.[320]

Some of the main functions of the Assembly include; determining standard policies of the Union, monitoring the implementation of policies and decisions of the Union, ensuring compliance by all Member States, appointing and terminating the appointment of judges of the Court of Justice.[321]

The Executive Council coordinates and takes decisions on policies in areas of common interest to Member States, including science and technology.[322] The Executive Council is also responsible to the Assembly. It considers issues referred to it and monitors the implementation of policies formulated by the Assembly.[323]

The Specialized Technical Committees (STCs), including the Committee on Industry, Science and Technology, Energy, Natural Resources, and Environment, are responsible to the Executive Council.[324] The STCs ensure the supervision, follow-up, and evaluation of the implementation of decisions taken by the Union.[325]

On the imposition of sanctions, the Assembly determines the appropriate sanctions to be imposed on any Member State that fails to comply with the decisions and policies of the Union.[326]

Having examined the structure of the African Union, including its decision-making and implementation mechanism, the African Union undeniably plays a crucial role in Africa's space development. In addition to the central leadership position and the existing detailed structure of the AU, most international organizations looking to drive developmental initiatives

[317] Article 20, Constitutive Act of the African Union.
[318] Article 22, Constitutive Act of the African Union.
[319] Article 7(1,2); Article 11(1,2), Constitutive Act of the African Union.
[320] Article 8; Article 12, Constitutive Act of the African Union.
[321] Article 9, Constitutive Act of the African Union.
[322] Article 13(1)(i), Constitutive Act of the African Union.
[323] Article 13(2), Constitutive Act of the African Union.
[324] Article 14(d), Constitutive Act of the African Union.
[325] Article 15(b), Constitutive Act of the African Union.
[326] Article 23(2), Constitutive Act of the African Union.

and projects in Africa usually approach the African Union for partnerships in achieving these programs.

The structure of the AU, including its decision-making and implementation procedures, make the African Union and its regional and international platforms crucial and desirable to driving developmental projects and program in Africa, including Africa's space sector development.

ANNEX – 2

A.2.1. Organizational Structure of the AfBD, Decision-Making, and Resources of the Bank

The African Development Bank (AfDB) Group is Africa's foremost development finance institution established to promote socio-economic development efforts and progress in Africa.[327] The AfDB Group is a multilateral development finance institution, comprising three distinct entities, which include; the African Development Bank (AfDB) as the parent institution[328] and two affiliates – the African Development Fund (ADF)[329] and the Nigerian Trust Fund (NTF).[330]

As of May 2015, the AfDB Group's membership comprised 54 African countries and 26 non-African countries.[331] The AfDB mobilizes internal and external resources to foster investment and provide technical support to the Regional Member Countries. It also mobilizes additional resources through co-financing with bilateral and multilateral development agencies.[332]

On the structure of the Bank, the Agreement establishing the AfDB[333] provides that "the Bank shall have a Board of Governors, a Board of Directors, a President, at least one Vice-President and such other officers and staff to perform such duties as the Bank may determine."[334] The Board of Governors is the supreme organ of the Bank. All the powers of the Bank are vested in the Board of Governors, and the Board issues general directives concerning the credit and operational policies of the Bank.[335] Each Member country is represented on the Board by a Governor and an Alternate.[336]

For any meeting of the Board of Governors, the quorum shall be a majority of the total number of governors or their alternates, representing not less than seventy percent of the total voting power of the members.[337]

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[327] "History", online: *AfDB* <www.afdb.org/en/about-us/corporate-infromation/history>

[328] The African Development Bank was created in Khartoum Sudan, following an agreement signed by 23 founding Member States on 14 August 1963 which became effective on 10 September 1964.

[329] The African Development Fund was established by the African Development Bank and thirteen non-African countries on 29 November 1972.

[330] The Nigerian Trust Fund was set up by the Government of the Federal Republic of Nigeria in 1976.

[331] History, *Supra*, note 327.

[332] "AfDB in Brief" (2013), online (pdf): *AfDB* <www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AfBD_in_Brief.pdf>

[333] Agreement Establishing the African Development Bank, signed on the fourth day of August 1963, in Khartoum, Sudan by 23 African Governments, and entered into force on the 10th day of September 1964.

[334] Article 4, Agreement Establishing the AfDB.

[335] Article 29, Agreement Establishing the AfDB.

[336] AfDB in Brief, *Supra*, note 332 at 12.

[337] Article 31(2), Agreement Establishing the AfDB.

The Board of Directors is responsible for the conduct of the general operations of the Bank.[338] The quorum for any meeting of the Board of Directors and the Board of Governors is the same.[339] The Board of Directors consists of 20 Executive Directors elected by the Board of Governors for a three-year term, renewable once.[340]

On voting, each member has 625 votes, and one vote for each share of the capital stock of the Bank held by that member. Also, each governor is entitled to cast the votes of the Member that such governor represents.[341] "All matters before the Board of Governors are decided by a majority of sixty-six and two-thirds percent of the voting power of the members represented at the meeting."[342] Each Director is entitled to cast the number of votes that counted towards the election of the Director. The vote is cast as a unit.[343]

The President of the Bank is elected by the Board of Governors for a five-year term renewable once. The President oversees the management and administration of the Bank.[344] The President is the Chairman of the Board of Directors and legal representative of the Bank, but he has no vote except a deciding vote in case of a tie.[345]

The resources of the Bank consist of ordinary and special funds/resources. The ordinary capital resources of the bank include authorized capital stock subscriptions, funds raised by borrowing, funds received in repayment of loans, income derived from loans, and any other funds or income received by the bank.[346]

The special resources which are the resources of the Special Funds. They include resources initially contributed to any Special Fund, funds borrowed for any Special Fund, Funds repaid for loans or guarantees financed from Special Fund, income derived from operations of the Bank, and any other resources at the disposal of any Special Fund.[347] The resources of the Bank shall be used exclusively for the socio-economic development of its regional members individually and jointly.[348]

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[338] Article 32, Agreement Establishing the AfDB.
[339] Article 34, Agreement Establishing the AfDB.
[340] AfDB in Brief, *Supra*, note 332 at 12.
[341] Article 35(1-2), Agreement Establishing the AfDB.
[342] Article 35(2), Agreement Establishing the AfDB.
[343] Article 35(3), Agreement Establishing the AfDB.
[344] Article 36, Agreement Establishing the AfDB.
[345] Article 37(1&3), Agreement Establishing the AfDB.
[346] Article 9 (1-6), Agreement Establishing the AfDB.
[347] Article 10, Agreement Establishing the AfDB.
[348] Article 12, Agreement Establishing the AfDB.

A.2.2. Financing Framework of the AfDB, Project Implementation and Evaluation

The Bank may provide or facilitate financing for any regional member in various ways such as: making or participating in direct loans from funds corresponding to its unimpaired subscribed paid-up capital or funds complementary to special resources;[349] participating in direct loans from funds borrowed or acquired by the Bank;[350] guaranteeing in whole or in part, loans made by others.[351] The various lending instruments of the Bank include project loans, lines of credit, sector investment and rehabilitation loan investments, sector and structural adjustment loans, technical assistance operations, budget support, and country system instruments.[352] Following negotiations with the respective government, a loan proposal is submitted to the Board of Directors of the Bank for approval, and the loan takes effect once agreed conditions are met. Some of these conditions include the presentation of a legal opinion, submission of investment schedule, designation of authorized signatories for the loan resources, opening a specialized project account, establishing a project implementation unit, etc.[353]

The implementation of projects at the AfDB commences upon a declaration that the project is effective. The executing agency is responsible for implementing the Bank's projects following the agreed schedule and procedures.[354] The Operations Evaluation Department of the Bank is responsible for using specific indices to measure projects and programs to determine if the objectives of the Bank's programs are achieved through these projects. The performance indices for evaluating the success of projects and programs include; the relevance and achievement of project objectives, borrower's implementation performance, adherence to the project timeline, institutional development performance, and project sustainability.[355]

[349] Article 14(1)(a)(i-ii), Agreement Establishing the AfDB.
[350] Article 14(b), Agreement Establishing the AfDB.
[351] Article 14(1)(d), Agreement Establishing the AfDB.
[352] AfDB in Brief, *Supra*, note 332 at 22-23.
[353] Ibid at 25.
[354] Ibid at 26.
[355] Ibid at 27.

ANNEX - 3

HIGHLIGHT OF RESEARCH RECOMMENDATIONS

This research reiterates that Africa will never attain self-sustainability and space capacity development by continually relying on foreign help and aid at all times. While foreign support is vital, what Africa learns to do for itself will better sustain the continent towards achieving Africa's development aspirations.

Although these international programs have made some progress in Africa, there is still so much that Africa needs to do for itself in leveraging space technologies for Africa's socio-economic development. There is danger in Africa's incessant reliance on international programs and support. Not only is this practice largely unsustainable, but it also promotes a mediocre mentality within the continent and hampers on indigenous space capacity development. Also, due to the crucial security and defense component of space endeavors, Africa will benefit more from developing indigenous space capacity, strengthening domestic regulatory framework for space activities and promoting intra-African space partnerships.

Below are some of the highlighted recommendations of this research.

A.3.1. STEM for the Next Generation of Africans in Space

The space policies of the U.S. and Canada details their commitment to supporting and developing their private space sector and, importantly, grooming and providing resources for the next generation to actively undertake STEM-related courses and pursue a career in STEM for the advancement of their space industry.

In developing Africa's space sector, each African country needs to prioritize the development of its younger generation in STEM. This next-generation support includes providing technical support in schools by incorporating relevant STEM courses in the school curriculum and providing relevant work opportunities for these young talents within Africa's space sector. In achieving this, schools in Africa with relevant space science and engineering courses and faculty can partner to implement exchange programs within Africa. This partnership can also be extended to schools abroad. Students of African descent can participate in STEM-related exchange programs abroad to broaden their knowledge in this field and develop their skillset to promote space technology development back in their home country.

A.3.2. The Operational Priorities of AfDB's Strategy: A Place for Space Financing in Africa

Having identified that space is not precisely one of the operational priorities of AfDB's strategy, this research recommends that the AfDB includes space in its operational priorities going forward as space plays a crucial role in Africa's development. Prioritizing space within the operational priorities of the Bank will go a long way in supporting space development projects and achieving the development aspirations of the continent, which both the AU and the AfDB aim to achieve.

A space financing framework within the AfDB will be crucial to achieving the internal continent funding option proposed by the AU African Space Strategy to promote an African-led space programme.

In developing an Africa-led space programme, the AU should refrain from encouraging the culture of Africa's extensive dependence on gratuitous donations from international partners and donor countries. Instead, the AU, in partnership with organizations like the AfDB, should encourage African countries, support them and help guarantee private funding for their space projects and programs. Through this, the AU and the AfDB, as key industry leaders, will fulfill their leadership role and duty of supporting Member States to achieve the 'Africa we Want.'

A.3.3. A Satellite Data Bank for Commercializing Africa's Satellite Data Market

For accessibility and boosting economic investment in the satellite data market in Africa, this research proposes a satellite data bank in Africa. This satellite data bank should be operated under the auspices of the African Union for a central system managed by the topmost leadership body in Africa.

The satellite data bank will be a repository of all satellite data in Africa. Each African country will have a registry for its satellite data and will be in charge of managing the registry. The satellite data bank should be accessible to both local and foreign consumers of satellite data.

This research notes some prominent concerns with satellite data commercialization which include; privacy, data protection, and copyright issues. Who owns the right to the respective satellite imagery? What rights are transferred to the purchaser of satellite imagery? What happens in the event of an infringement of the copyright of any State concerning its satellite imagery?

These are questions best addressed by the law. Due to the nature of rights attached to satellite imagery, this research proposes that the country with exclusive rights to its satellite imagery

(the seller) be in charge of executing individual contracts with purchasers of satellite imagery. The contract should be explicit on the nature and extent of rights transferred to the purchaser by the sale.

In addition, it will be helpful for each country to make provisions in its national law on the status, control, and use of acquired space data. For example, in the United States, the Commercial Space Act regulates the acquisition of space science data.

Also, in regulating the operation of the satellite data bank, a legal framework to be drafted by the AU, with contribution from all Member States, is vital. The legal framework for the satellite data bank must address various issues like the procedure for depositing satellite data, ownership of the satellite data, access to satellite data, and procedure for purchasing satellite data, transfer, and use of satellite data.

This satellite data bank not only makes it easy for both African and foreign countries to purchase satellite data in Africa, but it also provides a central access point for satellite data in Africa under the auspices of the AU.

A.3.4. Shortcomings of the NASDRA Act and Amendment Recommendations

There are many detailed questions unanswered by the NASDRA Act. Firstly, the Act lacks a comprehensive definition section. The Act appears to focus more on defining terms relating to the Agency and the functions of the Agency[356] instead of defining relevant terms relating to space activities within the purview of the Act's regulation.

Also, the NASDRA Act's provision on licensing of space activities restrictively focuses on remote sensing activities. The Act empowers the Council to grant anyone or corporation a license for activities stated in *Section 6(k) of the Act*.[357]

Section 6(k) of the Act provides that the Agency shall "be the repository of all satellite data over Nigeria's territory…"[358] Space activities transcend remote sensing activities. This provision of the NASDRA Act is very restrictive and suggests that it is majorly remote sensing activities that fall within the NASDRA Act for regulation. This provision must be amended for Nigeria to broadly regulate the varied space activities that can be carried out within its territory and by its nationals outside its territory. As a signatory to the Outer Space Treaty, Nigeria will bear international responsibility for the activities of its non-state actors in outer space.

[356] Article 36, NASDRA Act, 2010.
[357] Section 9(1), NASDRA Act, 2010.
[358] Section 6(k), NASDRA Act, 2010.

Another shortcoming of the NASDRA Act is its lack of a provision on offences and sanctions/penalties. The Act is silent on the consequences for contravening the conditions of a license or the Act's provisions in general. Could the Nigerian government be counting on its non-state actors/licensees to act in good faith? The NASDRA Act should be amended classifying offenses punishable under the Act, the punishment for contravening the conditions of a license or the provisions of the Act.

The NASDRA Act is also silent on the revocation or transfer of license. In the commercial space industry, transfer of license is not unusual. There are several reasons a licensee may desire to transfer its license. For example, change of ownership, merger, or acquisition of a company. Hence, the Act needs to make provisions on the procedure for transferring a license. Also, if a licensee is acting in contravention to the license terms, the Agency should have the power to revoke the license.

Furthermore, the provision on registration of space objects in the NASDRA Act does not adequately provide the particulars to be entered in the register. The Act vaguely provides that "there shall be entered in the register particulars of such objects as the Agency considers appropriate to comply with Nigeria's international obligations."[359] It will benefit private actors to know what particulars they will be required to provide to the Agency for the space objects register. This provision should not be vague and relatively discretionary.

The Act is also silent on property rights in space and the non-weaponization/demilitarization of outer space.

While the National Center for Remote Sensing, Jos, Plateau State, can go into satellite data acquisition, archiving, and distribution, the NASDRA Act is generally silent on the transfer, disposal, and use of dual-purpose technologies. In fulfilling its international obligation on the non-weaponization of space, the NASDRA Act must regulate dual-purpose technologies and non-state actors operating these type of technologies to avoid a contravention of this critical obligation.

This research recommends that Nigeria formulates and implements a separate Act solely focused on regulating space affairs instead of one Act that creates and regulates the Agency and the functions of the Agency while attempting to also regulate space affairs.

[359] Section 10(2), NASDRA Act, 2010.

A.3.5. Limitations of the South African Space Regulatory Framework and Amendment Recommendations

Although South Africa's domestic space laws address some of the inadequacies of the NASDRA Act, South Africa's national space laws are not without their limitations.

South Africa's space laws and Ethiopia's Space Policy are silent on avoiding the contamination of space and adverse change to the Earth resulting from the activities of its licensees. The Act fails to cover this vital consideration on the environment in fulfilling its obligation in *Article IX of the Outer Space Treaty.*

The Space Affairs Act of South Africa includes a limitation of liability clause, which states that "the State or any person in the employment of the State, the Minister or the Council shall not be liable in respect of anything done under this Act in good faith and without negligence."[360] This provision may be adequate if it seeks to limit the liability of the State for administrative issues resulting from the Act. However, if otherwise, South Africa's attempt to limit its international responsibility and liability by its national law might be insufficient.

South Africa will benefit more from incorporating mandatory insurance provisions for their non-state space actors and licensees, including recourse actions to limit the liability of the Republic.

As with Nigeria, South Africa's space laws are also silent on the in-orbit transfer of space objects. Their laws must provide the procedure for in-orbit transfer and notification of the relevant space Agency. This information will help the Agency update its space objects register and notify the UN-Secretary General on details of its space object in space.

Although South Africa is the only African country at present to have notified the UN Secretary-General of the launch of its national space registry, its national laws make no provision on the registration of space objects and are silent on the space registry. South Africa needs to update its national space laws to address these legal issues.

[360] Section 21, Space Affairs Act

A.3.6. Limitations of Ethiopia's Space Policy and Amendment Recommendations

Ethiopia occupies a unique position as the region does not have a national space law but only a national space policy. Ethiopia's Space policy focuses on Ethiopia's limitations in exploiting space tools and resources for the benefit of its citizens and the way forward. However, Ethiopia's Space Policy fails to make provisions on crucial issues like the liability of licensees or conditions for granting a license to their non-state actors.

The Policy lacks a detailed regulatory framework for space activities in the region and does not effectively regulate space affairs in Ethiopia.

Although Ethiopia's space policy provides for space affairs regulation, this provision is very skeletal in its form and nature. It emphasizes the government's mandate to the Ethiopian Space Science and Technology Institute (ESSTI) to "issue permits to persons desiring to engage in space activities, control their operations, register space objects, and regulate in collaboration with other relevant organs overall aerospace activities..."[361]

The Policy's strategies for space affairs regulation also merely aims to develop directives that clarify regulatory requirements on space objects and related activities. Ethiopia needs more than a skeletal regulatory framework for space activities within and outside the region.

Through a detailed national space legislation, Ethiopia can adequately regulate the activities of its non-state actors and fulfill its international obligations in the UN Space treaties, particularly the authorization and continuing supervision requirement in *Article VI of the Outer Space Treaty*. Also, through a dedicated national space law, the region can address liability issues arising from its non-governmental entities' activities.

Ethiopia needs to focus on forming a solid regulatory framework for private actors, space exploration, and space science and technology development in the region.

Ethiopia is encouraged to enact a national space law that focuses mainly on regulating space activities and fulfilling its international space obligations.

Notably, the space laws and policies of the States assessed make no provision relating to the rescue and return of astronauts and assistance to spacecraft personnel in accident, distress, or emergency landing. These obligations are also essential and should be covered by the space laws of African States.

A robust regulatory framework for space activities in each African State is crucial to developing indigenous space capacity, fulfilling international space obligations, and maximizing the benefits of space technologies for Africa's socio-economic development.

[361] Federal Democratic Republic of Ethiopia Space Policy (2018) at 15.