THE NIGERIAN SPACE PROGRAMME: JOURNEY SO FAR

Dr. M.O. Adepoju  
National Space Research & Development Agency (NASRDA), Airport Road, Abuja, Nigeria

CAPACITY BUILDING AND MANPOWER DEVELOPMENT FOR NATIONAL DEVELOPMENT
PRESENTATION OUTLINE

- Introduction
- Institutional Arrangements
- Strategic 25 Years Roadmap to Space Technology Development in Nigeria.
- Space Assets and Institutional Development
- Earth Observation Satellites
- Training and Capacity Building
- Communication Satellites
- Rocketry Programme
- Space Science and Technology Applications
- Space Science and Technology Spin-offs
- International Collaborations
- Conclusion
NIGERIA FORAY INTO SPACE

NIGERIA AS A MEMBER STATE

In 1959, the Committee had 24 members. Since then it has grown to 92 members – one of the largest Committees in the United Nations. In addition to States a number of international organizations, including both intergovernmental and non-governmental organizations, have observer status with COPUOS and its Subcommittees.

Nigeria became a Member State of COPUOS in 1973
Was established in 1999.

Is mandated to **vigorously pursue the attainment of space capabilities as an essential tool for its socio-economic development and the enhancement of the quality of life of its people.**

The Agency is to achieve this mandate through:

- *research*,
- *rigorous education*,
- *engineering development*,
- *design and manufacture of appropriate hardware and software in space technology*.

The National Space Research and Development Agency Act, 2010
Space Technology Program Implementation Committees

National Space Council Chaired by Mr President

- Technical Advisory Committee
- International Cooperation Committee
Institutional Arrangements

**NASRDA AND ITS OPERATIONAL CENTRES**

- Centre for Geodesy & Geodynamics (CGG), Toro
- Centre for Basic Space Science (CBSS), NSukka
- Centre for Space Transportation & Propulsion (CSTP), EPE
- Centre for Space Science & Technology Education (CSSTE), Ile-Ife
- Centre for Atmospheric Research (CAR), Anyigba
- GeoApps Plus Ltd., Abuja
- Centre for Satellite Technology Development (CSTD), Abuja
- National Centre for Remote Sensing (NCRS), Jos
NASRDA’s LABORATORIES

- ASTAL: Advance Space Technology Applications Laboratory
- ASTAL Uyo
- ASTAL Ile Ife
- ASTAL Kano
- Aerospace Engines Laboratory, Oka-Akoko, Ondo State
- Aircraft Engine Laboratory, Gusau, Zamfara State
- Unmanned Aerial Vehicle (UAV) Laboratory, Uburu, Ebonyi State
25-Year Roadmap to Nigeria’s Space Mission (2005-2030)

**ROAD MAP TO NIGERIA’S SPACE MISSION**

- **2030**: Launch of Nigerian Satellites from Nigerian Launch Pad (2030)
- **2028**: Large Scale Commercialization of Space Technology & Know-how (2028)
- **2026**: Spin-Off of Allied Industries – Electronics, Software etc. (2026)
- **2025**: Development of Rocketry/ Propulsion System (2025)
- **2018**: Development and Building of Made in Nigeria Satellites (2018)
- **2015**: Training of Nigerian Astronauts (2015)

**MILESTONE**
Space Assets
Earth Observation Satellites

**NASRDA Space Assets (1)**

NigeriaSat-1: 32m Multi-Spectral Imager (MSI)  
Launch: 27th Sep 2003  
Part of DMC  
De-Orbited 2012

NigeriaSat-2:  
2.5m Pan  
5m & 32m MSI  
Launch: 17th August 2011

NigeriaSat-X:  
22m MSI  
Launch: 17th August 2011  
Built by Nigerian KHTTs
NASRDA Space Assets (2)

NIGCOMSAT-1:
Launched: 13th May 2007
De-Ombited: 11th Nov 2008

NIGCOMSAT-1R:
Launched: 19th Dec 2011
Bands: C, Ku, Ka, and L
Uses: Tele-medicine, Tele-Education, Telephony, Tele-conferencing, Data Transfer, Television & Broadcasting, Security & Surveillance
Infrastructural Development

Space Museum
Planetarium

To Promote Interest in Science and Mathematics in Nigeria
Infrastructural Development

• Conference Centre with various Seminar Rooms (Round Room) and lodging for Scientists and Engineers in a secured environment
In 2001, the national space policy recommended the establishment of defense space command.

The Defense Space Administration was established in 2017 in line with NASRDA Space Policy and Programmes.

The Defense Space Administration is co-located with NASRDA headquarters in Abuja.

Grateful to Mr. President for Releasing the funds for the take-off of DSA.
TRAINING AND CAPACITY BUILDING
Globally, 62 and 200 officers are undergoing Ph.D. and M.Sc. Programmes, respectively.

- Total Number of Publications (Journals, Proceedings & In-review) is Over 1000
- Over 500 Officers and Men of the Armed Forces have been trained by NASRDA on the use of space based technologies for defence intelligence gathering at the Postgraduate Level.
- This saved Nigeria 1.7 billion Naira from oversea training cost.
- NASRDA will continue to conduct training for Armed Forces from time to time as the need arises.
- The Agency through GeoApps+ offered specialized training to participants from MDAs, the Military and Para-military. A total number of 57 personnel were trained in 2013.
MANDATE

• To develop skills and knowledge in four prime areas of Space Science Technology: Remote Sensing/GIS; Satellite Meteorology & Global Climate; Satellite Communication and Basic Space & Atmospheric Science, Global Navigation Satellite Systems.

VISION

• Human Resources Development and Public Awareness in Africa of the benefits and applications of Space Science & Technology for the sustainable development and improvement on the quality of life of the people, through rigorous education/ training and outreach programmes.
Mission

ARCSSTE-E was established to build high quality capacity and a critical mass of indigenous space Scientists, Engineers and Educators in English speaking African countries for the development and application of space science & technology for sustainable national & regional development.
Master’s Program

The Masters programme in remote sensing and GIS is in collaboration with the Federal University of Technology, Akure (FUTA).

At the end of the programme, participants are awarded a Master of Technology (M.Tech) degree in their chosen area of specialization. So far, over eighty (80) participants have graduated since the inception of the programme in 2013.
Post Graduate Diploma


Since 1999 when the Centre began offering these courses, more than 400 participants from Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mozambique, Nigeria, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, The Gambia, Uganda and Zimbabwe have passed through the Postgraduate Diploma programme.
# Programme Structure

<table>
<thead>
<tr>
<th>Course</th>
<th>Programme</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Sensing and GIS</td>
<td>PGD/Masters</td>
<td>9 months/18 Months</td>
</tr>
<tr>
<td>Satellite Communications</td>
<td>PGD/Masters</td>
<td>9 months/18 Months</td>
</tr>
<tr>
<td>Global Navigation Satellite Systems</td>
<td>PGD</td>
<td>9 months</td>
</tr>
<tr>
<td>Basic Space and Atmospheric Science</td>
<td>PGD</td>
<td>9 months</td>
</tr>
<tr>
<td>Space Meteorology</td>
<td>PGD</td>
<td>9 months</td>
</tr>
</tbody>
</table>
PGD Graduates
ARCSSTE-E runs a vibrant Outreach Programme designed to create public awareness, sensitize nursery/primary and secondary school children in the area of space science and technology education.

These workshops provide opportunities for students to try their hands on different science-based activities like assembling of mock-ups of satellite, rocket, rocket launchers and performance of simple on-the-spot experiments.
Facilities

SATELLITE COMMUNICATION LECTURE ROOM
Source: www.arcsstee.org.ng
The Institute of Space Sciences & Engineering (ISSE) was established in Abuja on 2nd June, 2015 in accordance with (NASRDA) Act 2010.

The Institute ia an Affiliate of African University of Science & Technology (AUST)

It is a unique postgraduate Institute set to address the growing needs of Space Science and Engineering skills, knowledge and innovations in Nigeria and Africa continent at large.

The Institute comprises of Department of Space Sciences and Department of Space Engineering Systems with programmes drawn from the specialized studies in Space Sciences, Engineering, Mathematics, Computerization, and Technology Innovations leading to the award of MSc and PhD.

The first set of MSc. And PhD Students commenced in 2019.
## Programme Structure

<table>
<thead>
<tr>
<th>Course</th>
<th>Programme</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Physics.</td>
<td>MSc. / PhD</td>
<td>18 Months/36 Months</td>
</tr>
<tr>
<td>Systems Engineering</td>
<td>MSc. / PhD</td>
<td>18 months/36 Months</td>
</tr>
<tr>
<td>Aerospace Engineering</td>
<td>MSc. / PhD</td>
<td>18 Months/36 Months</td>
</tr>
<tr>
<td>Geographic Information Science and Geoinformatics</td>
<td>MSc. / PhD</td>
<td>18 Months/36 Months</td>
</tr>
</tbody>
</table>
Earth Observation Satellites
Earth Observation Satellites

NigeriaSat-X Image over Oakland, New Zealand
Earth Observation Satellites

NigeriaSat-1 Achievements

- Donation of Satellite Imageries to Nigerian Universities
  - 2011 - date
  - Over 4000 Images donated
  - Worth over N3.5 Billion Naira

- Detailed Resource Inventory of Nigeria
  - 2007
  - Scale: 1:100,000
  - Saved Nigeria over N4 Billion

- Satellite Atlas of Nigeria
  - 2013
  - Images used to produce first ever Nigerian Satellite Atlas
  - Saved Nigeria N3 Billion

- Domestication of GIS technology through Collaboration
  - 2010 - date
  - 35 GIS / Remote Sensing laboratories established in Nigerian Universities
Earth Observation Satellites

NigeriaSat-2 and NigeriaSat-X Achievements

Donation of Satellite Imageries to Nigerian Universities / INEC
- NX images to 35 Nigerian Universities for Research
- INEC for Delimitation of Constituencies in 2013/2014
- Worth over N4.5 Billion Naira

Commenced Detailed Resource Inventory of Nigeria
- Scale: 1:50,000
- Completed South West and North Central Nigeria (Except Benue)
- Would save Nigeria about N5 Billion when completed

Support to Armed Forces and National Security
- Images of North-East
- Images of Mali for Peace Keeping Operations
- Vulnerability Maps of Nigeria Major Cities
Earth Observation Satellites

Technology Transfer

**N-1**
- 15 Engineers and Scientists were trained

**N-2**
- 25 Nigerian Engineers and Scientists were trained

**NX**
- The Trained Engineers and Scientists Built NX
The programme consists of 5 CubeSats belonging to Japan as well as:
- Nigeria,
- Ghana,
- Mongolia and
- Bangladesh

Space X Falcon9 Rocket launched the satellites from Kennedy Space Centre in Florida, USA on June 6th 2017.

Nigerian engineers and scientists build the ground station for the satellite.
Earth Observation Satellites

In the North East, we are still limited by the type of satellite in use. In consultation with the Defense Space Administration, there is need for development and launch of:

1. Sub-meter earth observation satellite.
2. 50kg Earth observation satellite with 2 meter spatial resolution.
4. 20 4U Nano satellite constellation;
   - This will increase temporal resolution
   - The cost is cheap
   - Enable our engineers to demonstrate acquired skills and increase confidence.
5. Assist in overcoming the international politics of technology transfer.
Rocketry Programme
Rocketry Programme

NASRDA/DSA COLLABORATION FIRST FLIGHT (CS/DS-I)
17, Nov 2015.

1 - 10km Launch Capability in Nigeria has been achieved
1 - 20km Launch Capability in Nigeria has been achieved.
Rocket Weight has been reduced.
Versatility has been improved.
Improved Local Fuel Mixture
Missiles Development in Collaboration with Armed forces
Surface to Air
Air to Air
Ground to Air
100km Target by 2019.
Rocketry Programme

Collaboration With Air force

Shoulder Launcher
Smoke Generator in Collaboration With Air force

Fuel injector

Smoke oil injectors

Region of expansion through De-laval nozzle

Ignition point

Air Force Personnel

Nose cone
Umbilical cord
Main Control Box
Fuel pump
Supply Port
Oil tank
Oil pump
Solenoid valve
Combustion Chamber
Fuel filter
Fuel tank
Drain Port
Oil filter
Ignition Coil
Oil supply manifold
De-laval nozzle
Communication Satellite
Communication Satellite

NigComSat-1 was launched in 2007 and replaced by NigComSat-1R:
Launched on the 19th of December 2011

Before the Commercial handover

- Executive Communication
  - Established Secured communication links between Mr. President and the Governors and other top security personnel

- Tele-education
  - National Open University

- Bandwidth Provision
  - e.g. Nigerian Army 1-Division
Initiated in 2006 in collaboration with Ministry of Health
Took medical facilities to unreached rural areas in the six geopolitical zones
NASRDA also has six fixed remote bases at FMCs and Two Federal University Teaching hospitals
Bagged an African Award in 2009 during the AU summit in Addis-Ababa for the deployment of telemedicine to accelerate the achievement of MDG’s goals in 2015.
It is recommended that Mr. President should direct the Federal Ministry of Health to scale up the project for the entire country.
Communication Satellite

Way Forward

- The capital flight annually due to communication satellite products is $1 Billion in Nigeria and about $500 million in South Africa.
- West Africa remains a major strategic market for communication satellite products.
- It is essential to promote private sector investment in West Africa through ECOWAS.
- For Nigeria, it will be a major strategy for economic diversification.
- NASRDA can secure orbital slots for the private sector at the International Telecommunication Union (ITU).
- Financial institutions can be encouraged to provide financial guarantees to the private sector investors.
Space Science and Technology Applications
NASRDA conducted Seasonal Hydrological feedbacks from 2003 - 2010 for Lake Chad Basin.

This has increased partnership with stakeholders in the region.

NASRDA is currently working with the Federal Ministry of Water Resources.
Response to Flood in 2011 and 2012
Natural Resource Inventory Of The FCT For Sustainable Development
Space Based Assessment Of Environmental Sensitivity To Desertification In Katsina State
Completion of National Satellite Atlas of Nigeria from NigeriaSat-1 Satellite Imagery
SPACE APPLICATIONS RESEARCH OUTCOMES

Spatial Distribution of Schools

Spatial Distribution of Primary and Junior Secondary Schools in Nigeria
DIGITAL POST CODE
Satellite Image of Postcode zones

NIPOST HQTRS
Garki Area 11
Post Code: FC 2 14BK

NDE Building Wuse Zone 2
Post Code: FC3 2AX
SECURITY & Defence - Crime Prevention

Modern Surveillance Technology

National Defence

GIS DATA MANIPULATION & QUERY
National Space Research and Development Agency

Planning:

- Urban and Regional Planning,
- Urban Renewal and Change Studies
- Feasibility Study, Landuse Mapping,
- Land Administration,
- Location of Industries.

Urban Fabrics (Slum)
**Transportation:**
- Roads, Railway and Airport Runway Design
- Aeronautic Charts for Navigation,
- Search and Rescue Operation.

Road Measurement from Satellite Images
Geospatial and Statistical Analysis
The buffering of 10m, 20m, 50m and 100m was done around the Base Transceivers Stations (BTS) to be able to run a proximity analysis to BTS in the environs. Figures above show the buffered zones around BTS in Utako/Jabi, Wuse and Garki Districts.

Recommendation
There should be proper awareness on the possible health risk on people living close to a Base Transceivers Station (BTS). The regulatory agencies should keep checks on service providers that violate the 10m and 12 m of siting BTS away from residential areas as stated in the NESREA regulations for telecommunication and broadcasting standards. The regulatory agencies should also invest in R&D in order to confirm all others studies and complains about electromagnetic radiation and thermal heat causing health problems so that a more reasonable buffer zone for BTS siting will be issued as a regulation to service providers.
SPACE-BASED ASSESSMENT OF GSM COMPLIANCE


- Space-Based Assessment of the Compliance of Gsm Operators in Establishing Base Transceiver Station (Bts) In Nigeria Using Abuja Municipal Area Council as Case Study Aderoju Olaide M, Godstime James, Olojo Olabamiji, Oyewumi Ademuyiwa, Eta Joseph, Onuoha Hilda U, Salman Khalid, Nwadike Blessing K. Department of Strategic Space Application, National Space Research and Development Agency (NASRDA), Abuja, FCT, Nigeria.
NASRDA has developed a real time monitoring system for monitoring national security entities in the country.

The technology is based on Automated Identification System (AIS).

The system is capable airports and the Nigerian Maritime real time monitoring.
Sample Space Spin-off Products

• In-Car Navigator Pro-43

For Monitoring of Space Weather; Earth Movement

• Embedded Prototyping Kit (EPK)
  • For Computer Aided Control
Sample Space Spin-off Products

Autonomous Robotic System for Spacecraft and Rocket Control

A Mobile Control Station for Rockets and Missiles Launch

Collaboration with NASA for the use of Global Navigation Satellite Systems (GNSS)

- NASRDA signed an agreement with NASA, USA for the use of the GNSS for Geodetic Application.
- A core GNSS reference station has been established by NASA in Toro, Bauchi State.
- The Station provides the most reliable data in Africa and ranks amongst the top 100 worldwide.
High Precision GPS Device

Env. Mon. & Gas Pollution Detector

Range Finder

IR non-contact Thermometer

Intrusion Detection & Alert System

EPSm Station
Remote timing / trigger System

Multi – level Temperature meter

Radio Telescope Dish Antenna

SERT - X

3 – Axis Magnetometer

Scientists and Engineers at work
International Collaboration
NASRDA, on behalf of Nigeria is playing a major role in Space Science in Africa.

NASRDA is a member of the Africa Leadership in Space Conference (ALC).

The ALC is currently serving in advisory capacity to the African Union Heads of State.

NASRDA is also a member of the African Resource Monitoring Satellite Constellation (N2 is the first satellite in the constellation).

NASRDA is instrumental to the development of the African Space Policy.

NASRDA is currently hosting the Regional Support Office of the United Nation Platform for Space-based Information for Disaster Management and Emergency Response (West and Central Africa).

ARCSTEE (affiliate of UNOOSA) trains English Speaking African Countries in Space Science and Technology.

World Bank Erosion Mapping, Deforestation,

GRID3 (CIESIN Grant)

GEO, GEOSS, ECOWAS etc.
The Space Programme is only 20 years old.
Nigeria is the first nation in Africa to establish a Space Agency and today, 15 other African countries have joined.
So many achievements have been attained during this period.
The Space Programme remains a strategic vehicle for the achievement of the socio-economic development of our nation as well as the attainment of the Economic Recovery and Growth Plan programme of the Federal Government.
NigeriaSat-1 and X

NigeriaSat-2

NigComSat-1R

THANK YOU