THE NIGERIAN SPACE PROGRAMME: JOURNEY SO FAR

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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

Introduction

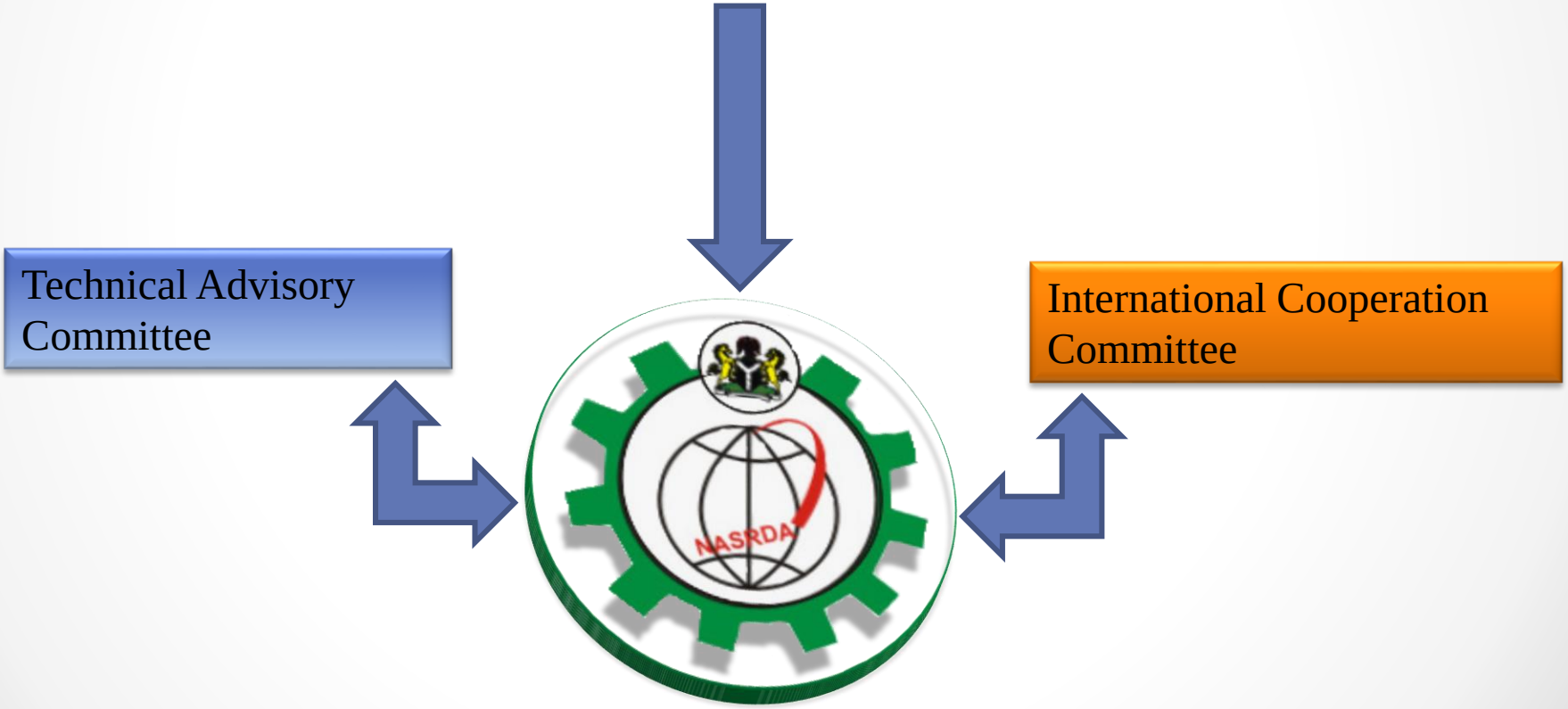
National Space Research and Development Agency

- **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

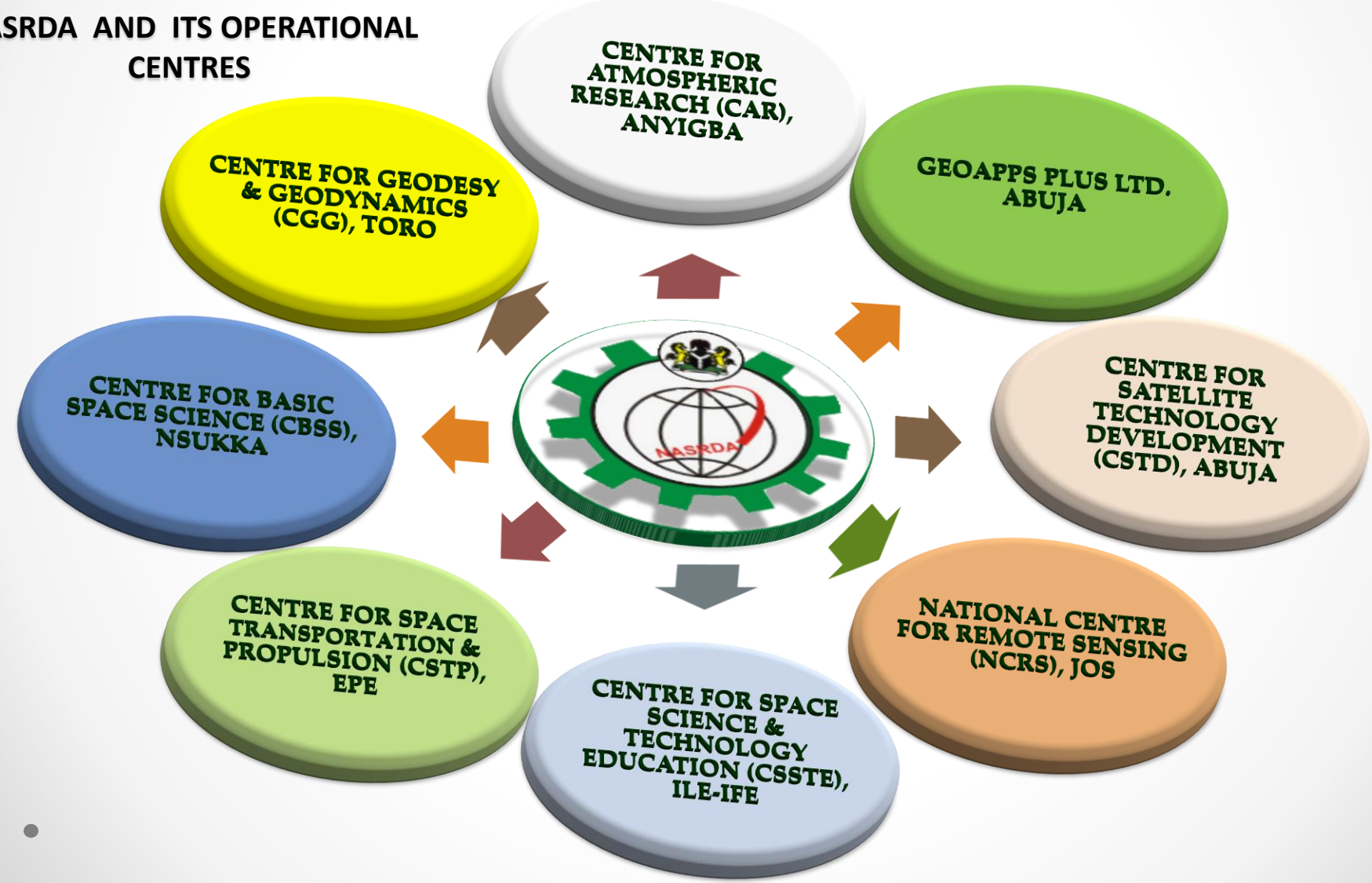
National Space Council Chaired by

Mr President



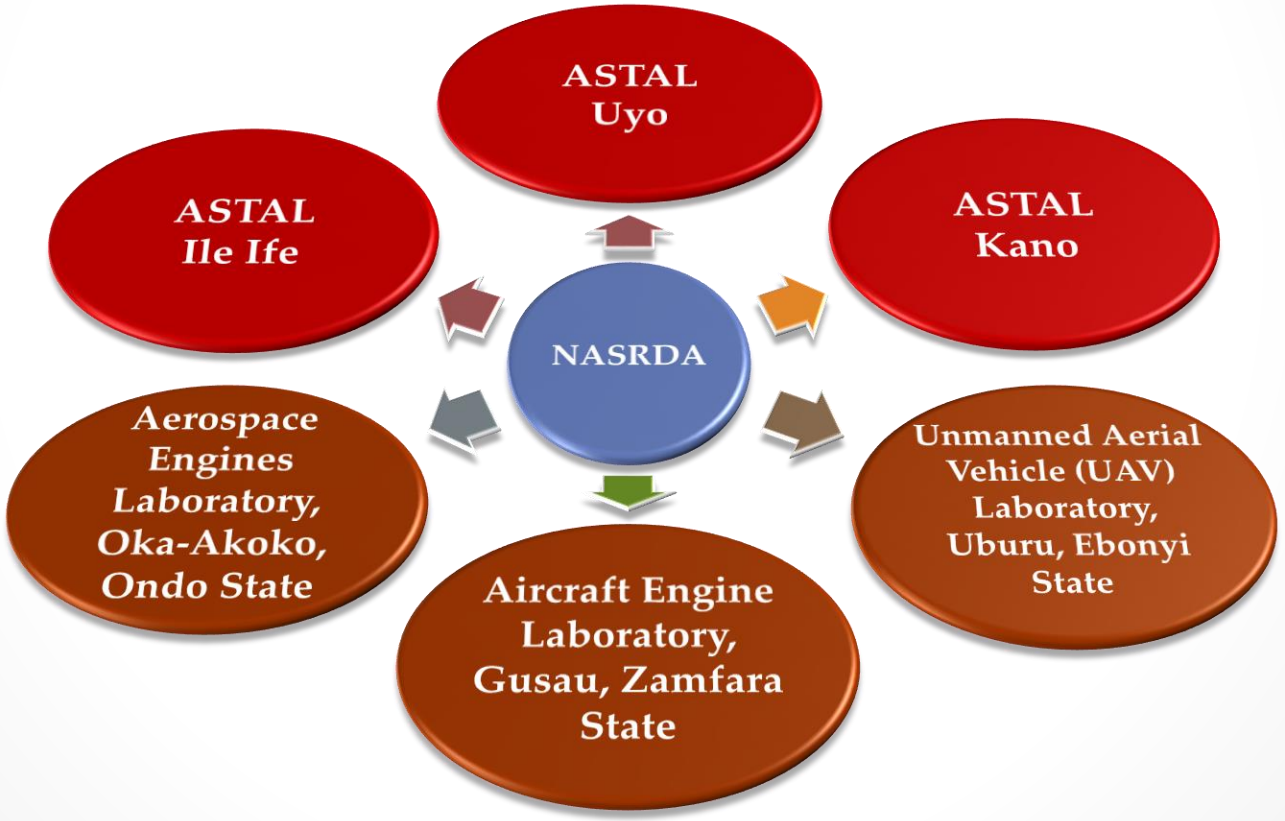
Institutional Arrangements

NASRDA AND ITS OPERATIONAL CENTRES



Institutional Arrangements

NASRDA's LABORATORIES



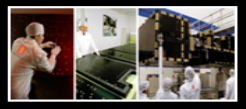
ASTAL: Advance Space Technology Applications Laboratory

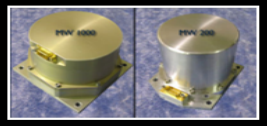
25-Year Roadmap to Nigeria's Space Mission (2005-2030)

TIME

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)

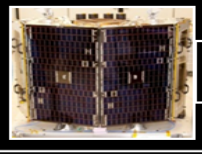
2026 —  Spin-Off of Allied Industries – Electronics, Software etc. (2026)

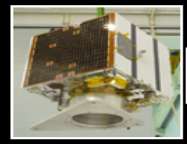
2025 —  Development of Rocketry/ Propulsion System (2025)

2018 —  Development and Building of Made in Nigeria Satellites (2018)

2015 —  Training of Nigerian Astronauts (2015)

 AstroSAR (2015)

2011 —  NigeriaSat-2 (2011)

 NigeriaSat-X (2011)

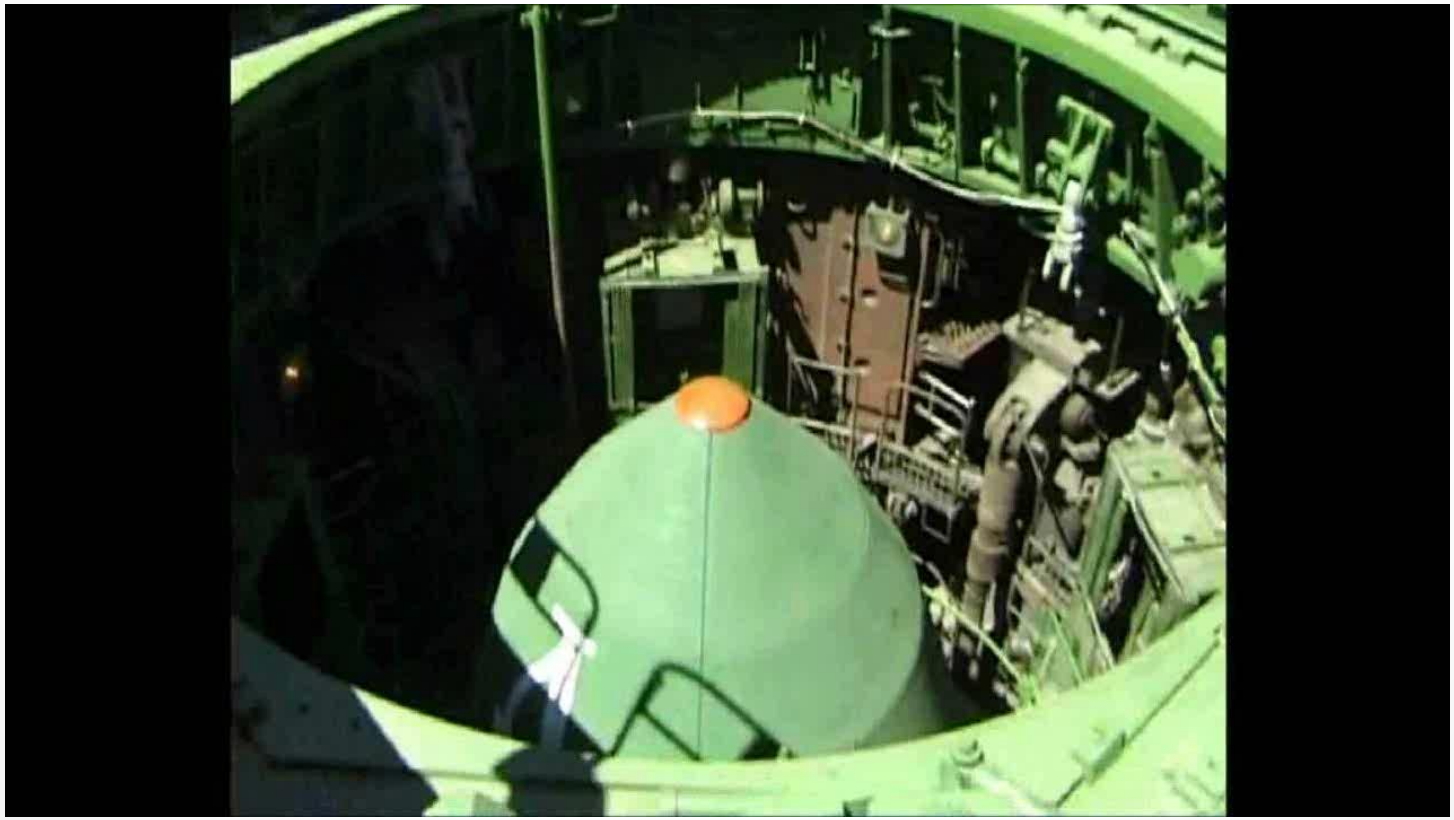
 NigComSat-1R 2011

MILESTONE

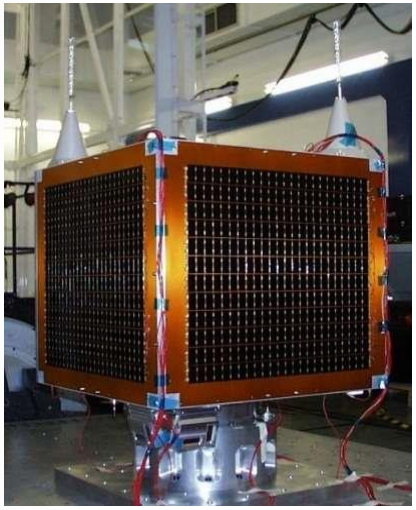
Space Assets

Earth Observation Satellites

Satellites Launched: NigeriaSat-1 (2003), NigeriaSat-X (2011), NigeriaSat -2 (2011)

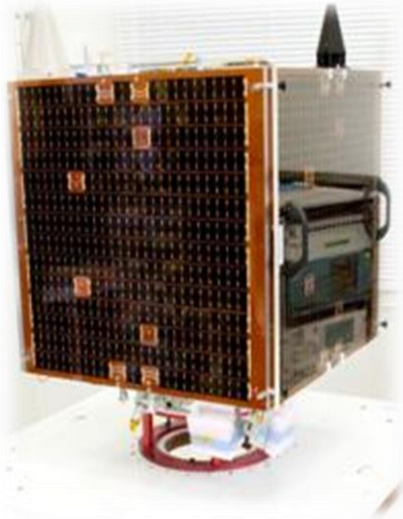


NASRDA Space Assets (1)



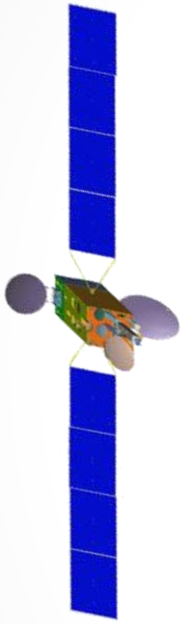
NigeriaSat-1: 32m Multi-Spectral Imager (MSI)
Launch: 27th Sep 2003
Part of DMC
De-Orbited 2012

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-Orbited:
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 Developent

Space Museum

Planetarium

To Promote Interest in Science and Mathematics in Nigeria

Infrastructural Development

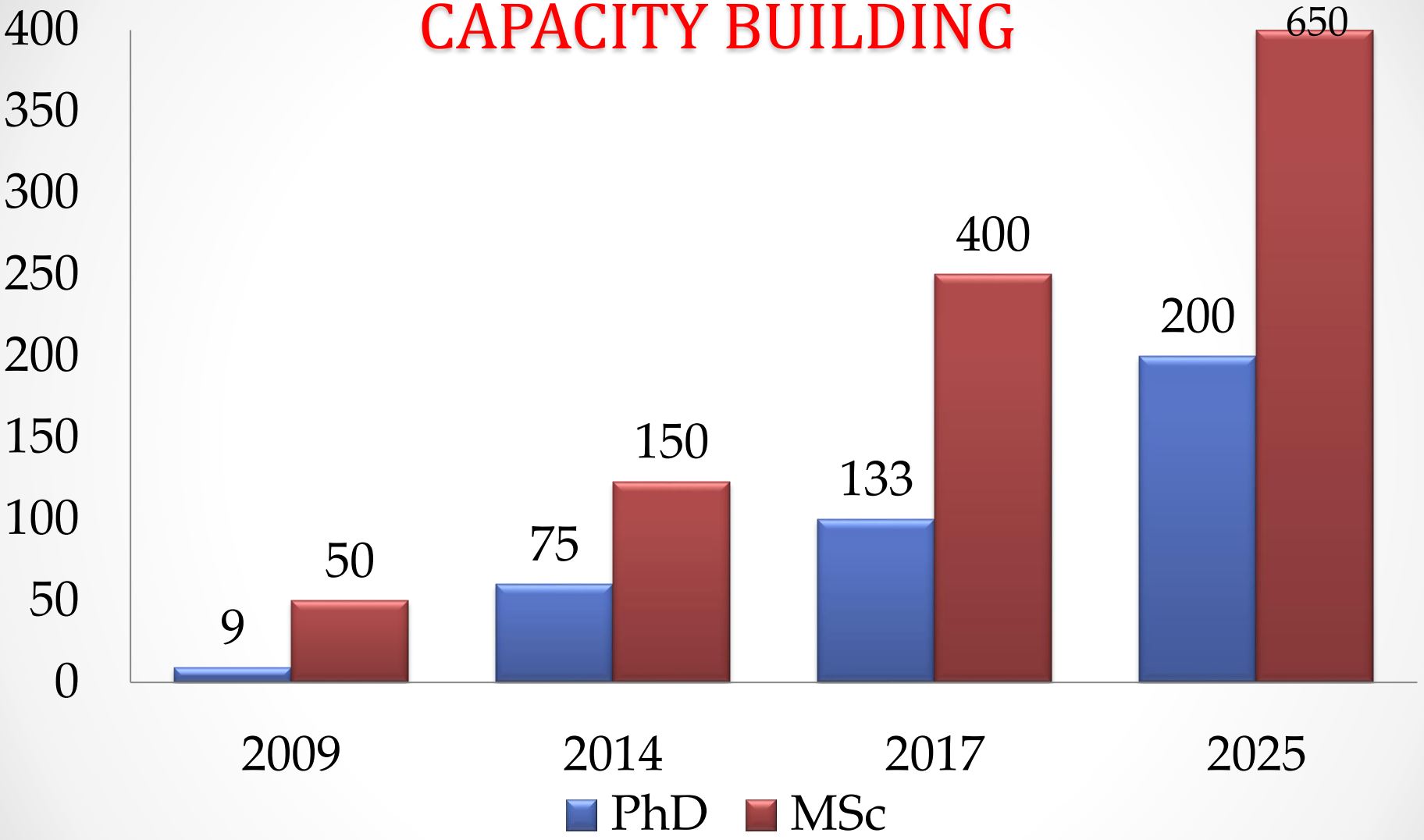
- Conference Centre with various Seminar Rooms (Round Room)and lodging for Scientists and Engineers in a secured environment

Establishment of Defense Space Administration

- 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

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

Capacity Development Support

- 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 1.7billion 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.

AFRICAN REGIONAL CENTRE FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION IN ENGLISH (ARCSSTE-E)

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

ARCSSTE-E offers PGD in Remote Sensing and GIS, Satellite Communications, Global Navigational Satellite Systems, Basic Space and atmospheric science, Space meteorology

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

Course	Programme	Duration
Remote Sensing and GIS	PGD/Masters	9 months/18 Months
Satellite Communications	PGD/Masters	9 months/18 Months
Global Navigation Satellite Systems	PGD	9 months
Basic Space and Atmospheric Science	PGD	9 months
Space Meteorology	PGD	9 months

PGD Graduates

Space Education Outreach

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

Institute of Space Science and Engineering (ISSE)

- 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

Course	Programme	Duration
Space Physics.	MSc. / PhD	18 Months/36 Months
Systems Engineering	MSc. / PhD	18 months/36 Months
Aerospace Engineering	MSc. / PhD	18 Months/36 Months
Geographic Information Science and Geoinformatics	MSc. / PhD	18 Months/36 Months

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

Nano Satellite: Nigeria EduSat-1

Ground Station Antenna during Testing Phase

- 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.

NASRDA engineer installing the Ground Station Antenna

Earth Observation Satellites

Way Forward

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

Rocketry Programme

Rocketry Programme

***1 - 10km** Launch Capability in Nigeria has been achieved*

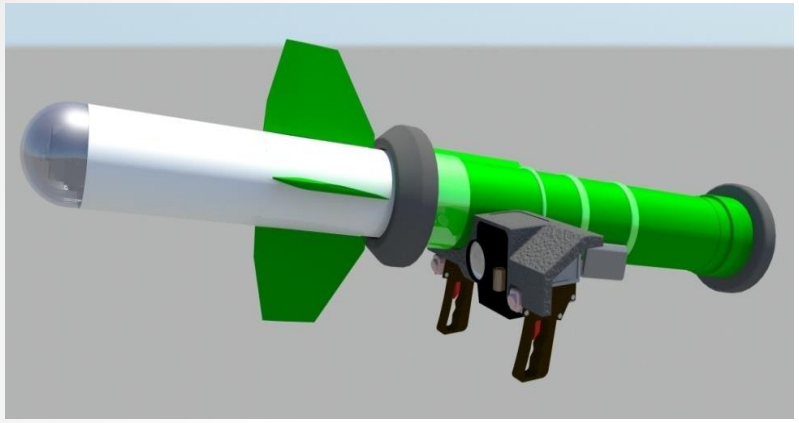
THE NASRDA ROCKETRY PROGRAMME

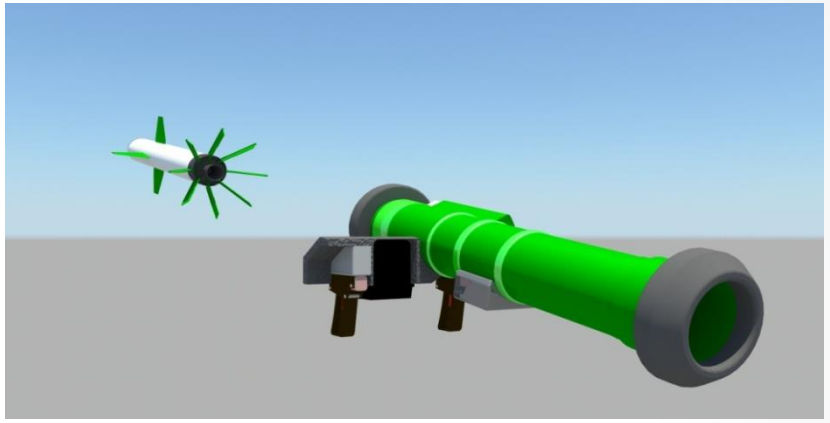
- *1 - 20km Launch Capability in Nigeria has been achieved.*
- *Rocket Weight has been reduced.*
- *Versatility has been improved.*
- *Improved Local Fuel Mixture Missiles Development in Collaboration with Armed forces*
  - *Surface to Air*
  - *Air to Air*
  - *Ground to Air*
- *100km Target by 2019.*

2 Stage Rocket-2016

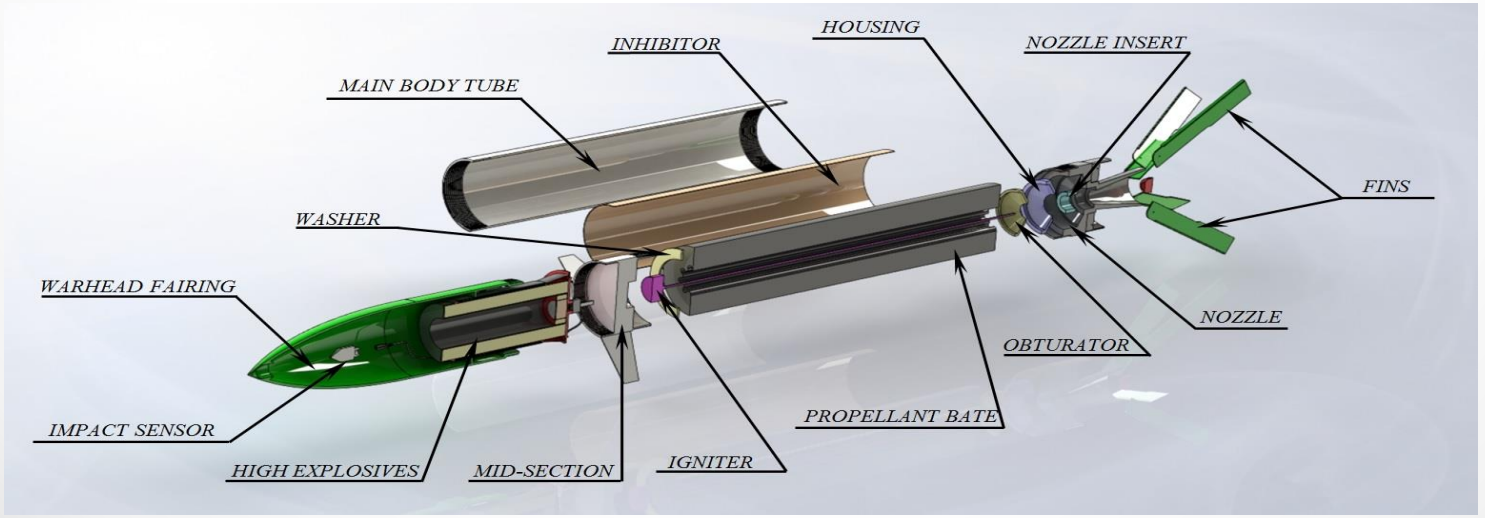
Rocketry Programme

Collaboration With Air force

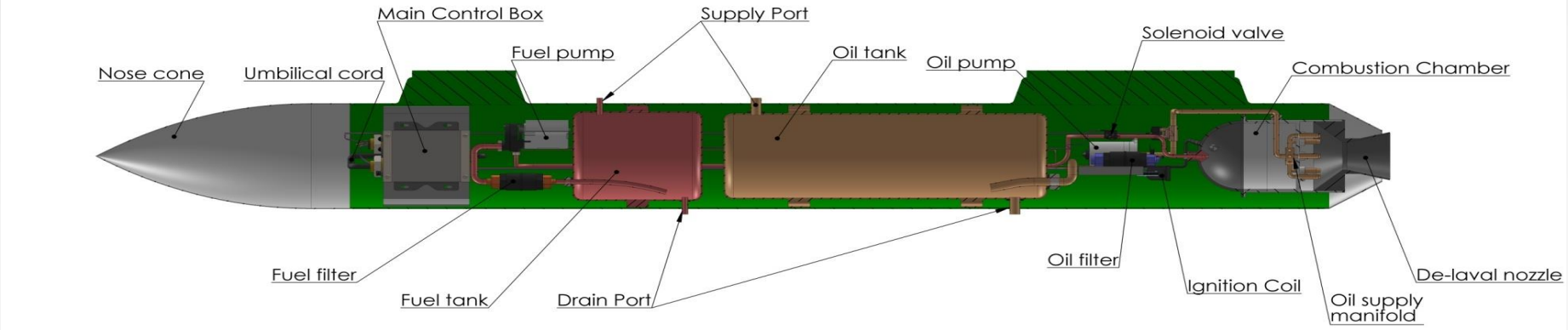




Shoulder Launcher



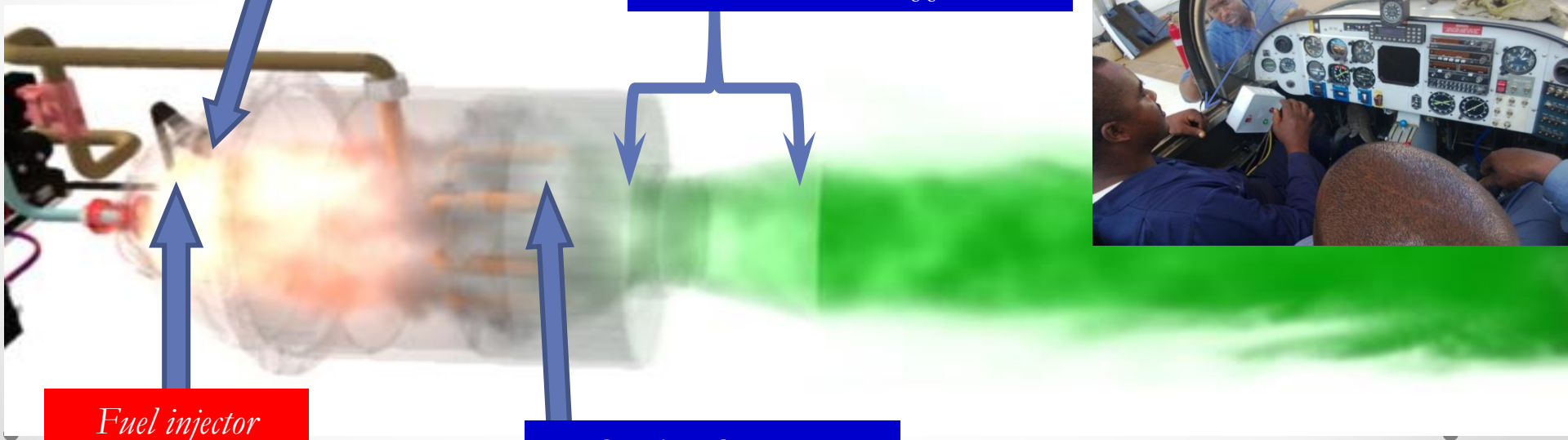
Smoke Generator in Collaboration With Air force



Ignition point

Region of expansion through De-laval nozzle

Air Force Personnel



Fuel injector

Smoke oil injectors

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

Communication Satellite

Telemedicine

Pilot Project

- 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.

Tele-Van

Technology in Government in Africa (TIGA) Award

Communication Satellite

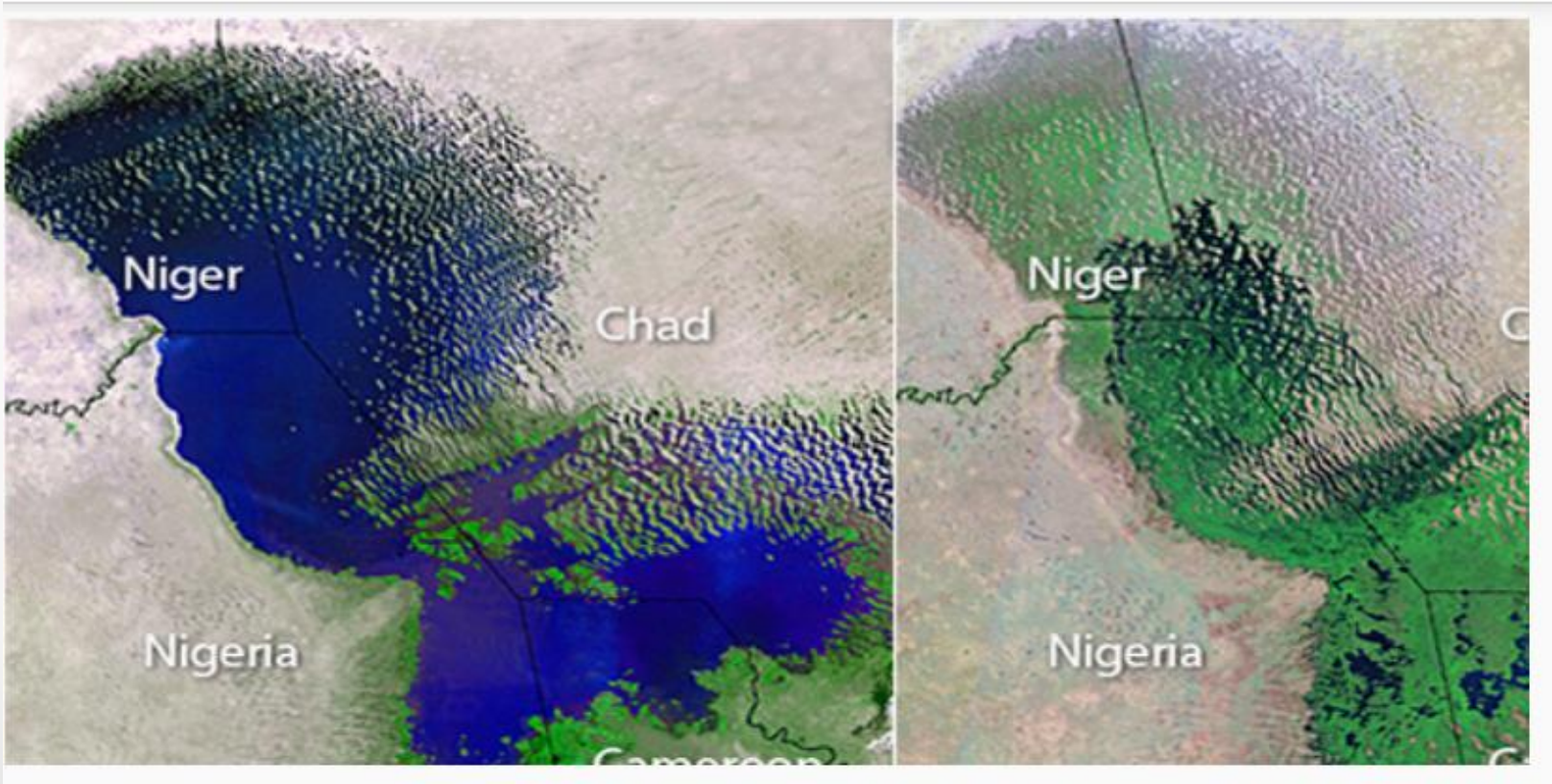
Way Forward

- 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.

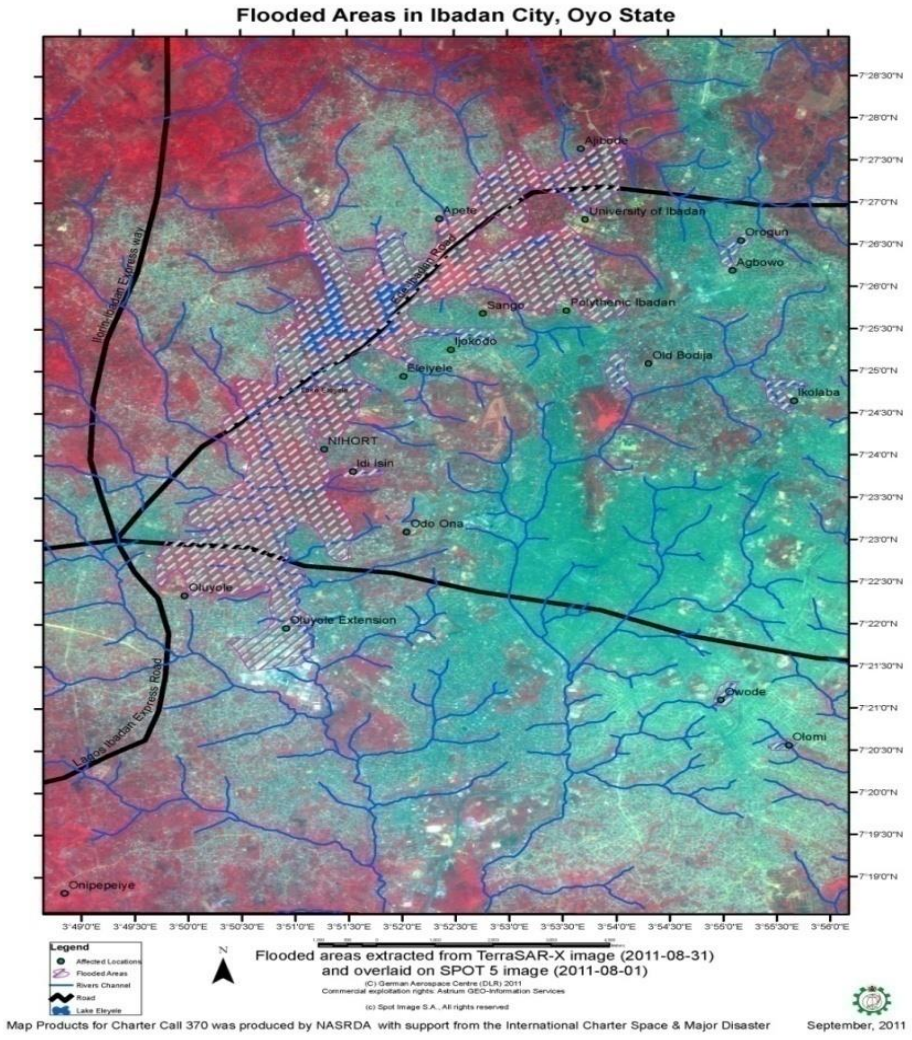
Space Science and Technology Applications

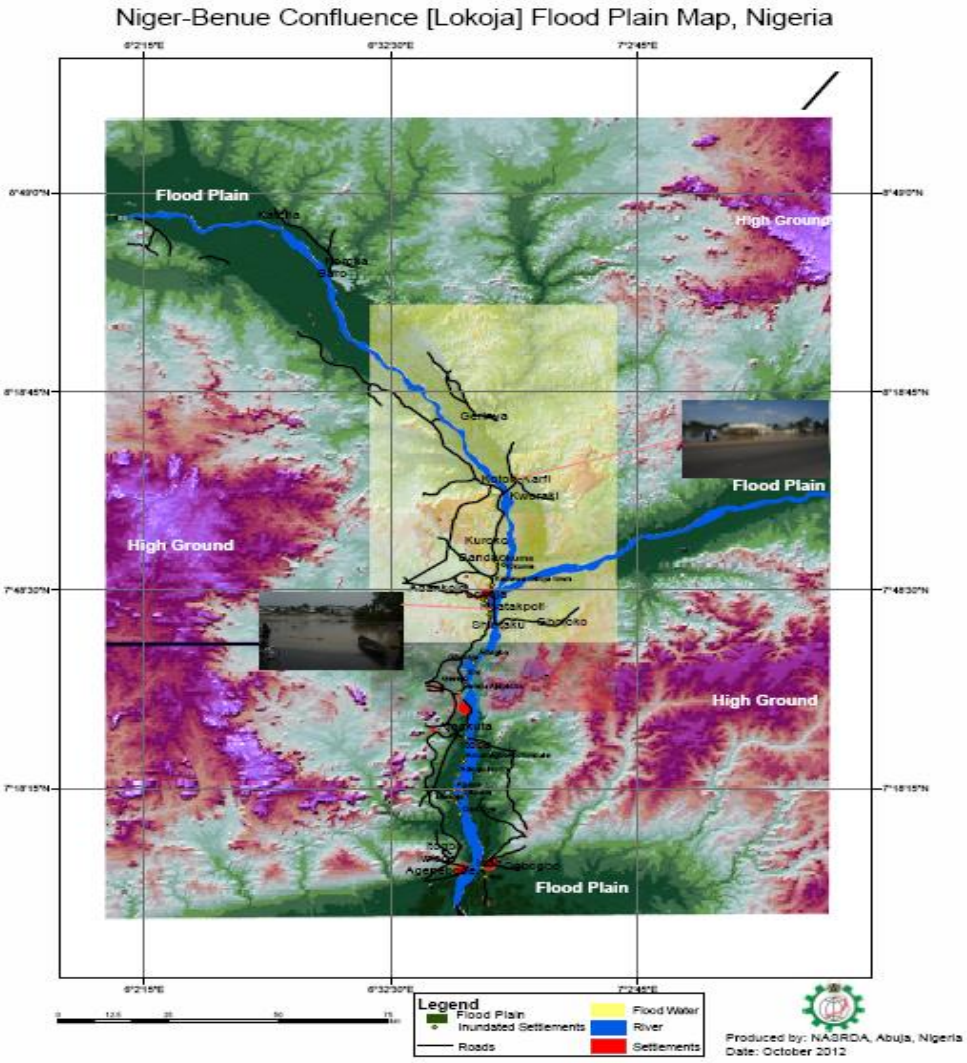
Lake Chad Interventions

- 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.

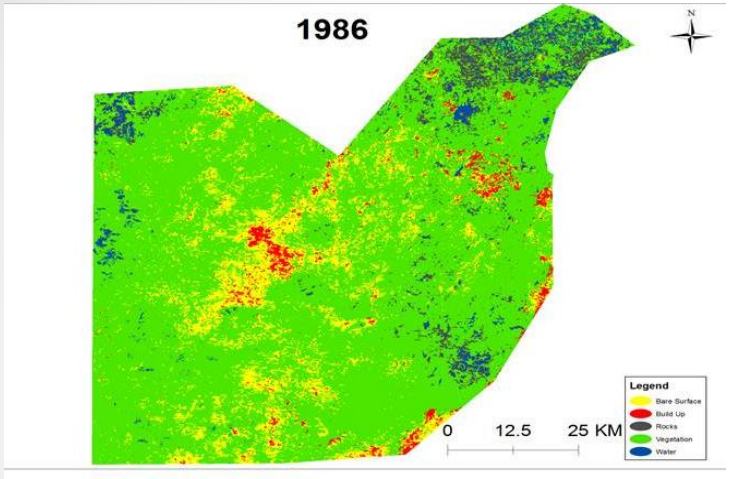


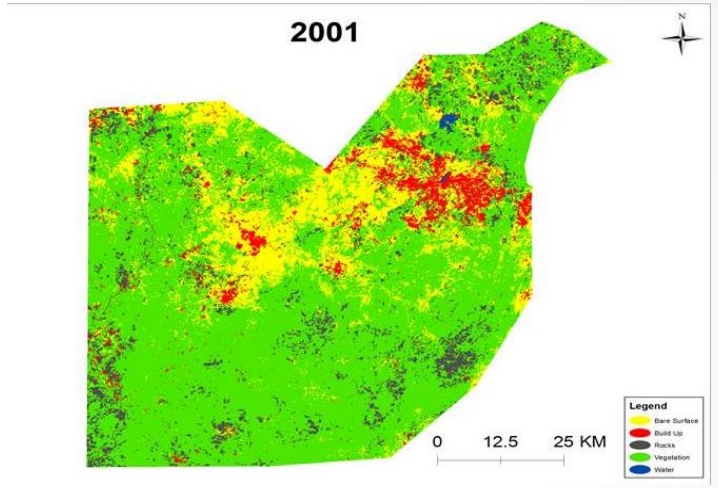
Response to Flood In 2011 and 2012

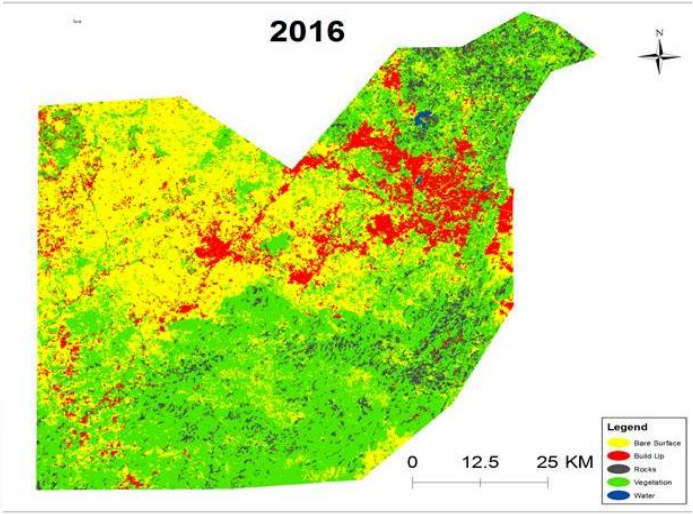




Natural Resource Inventory Of The FCT For Sustainable Development

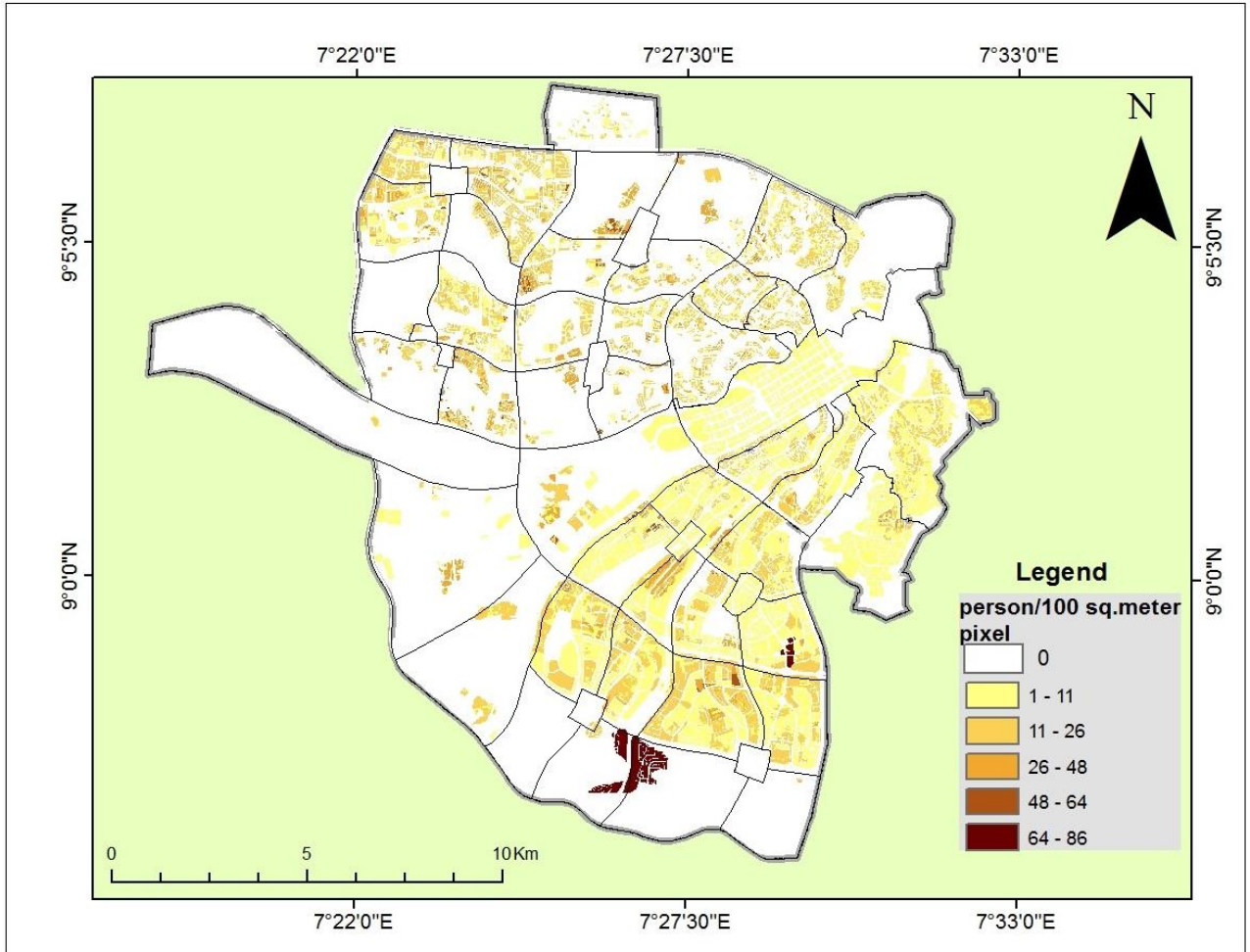






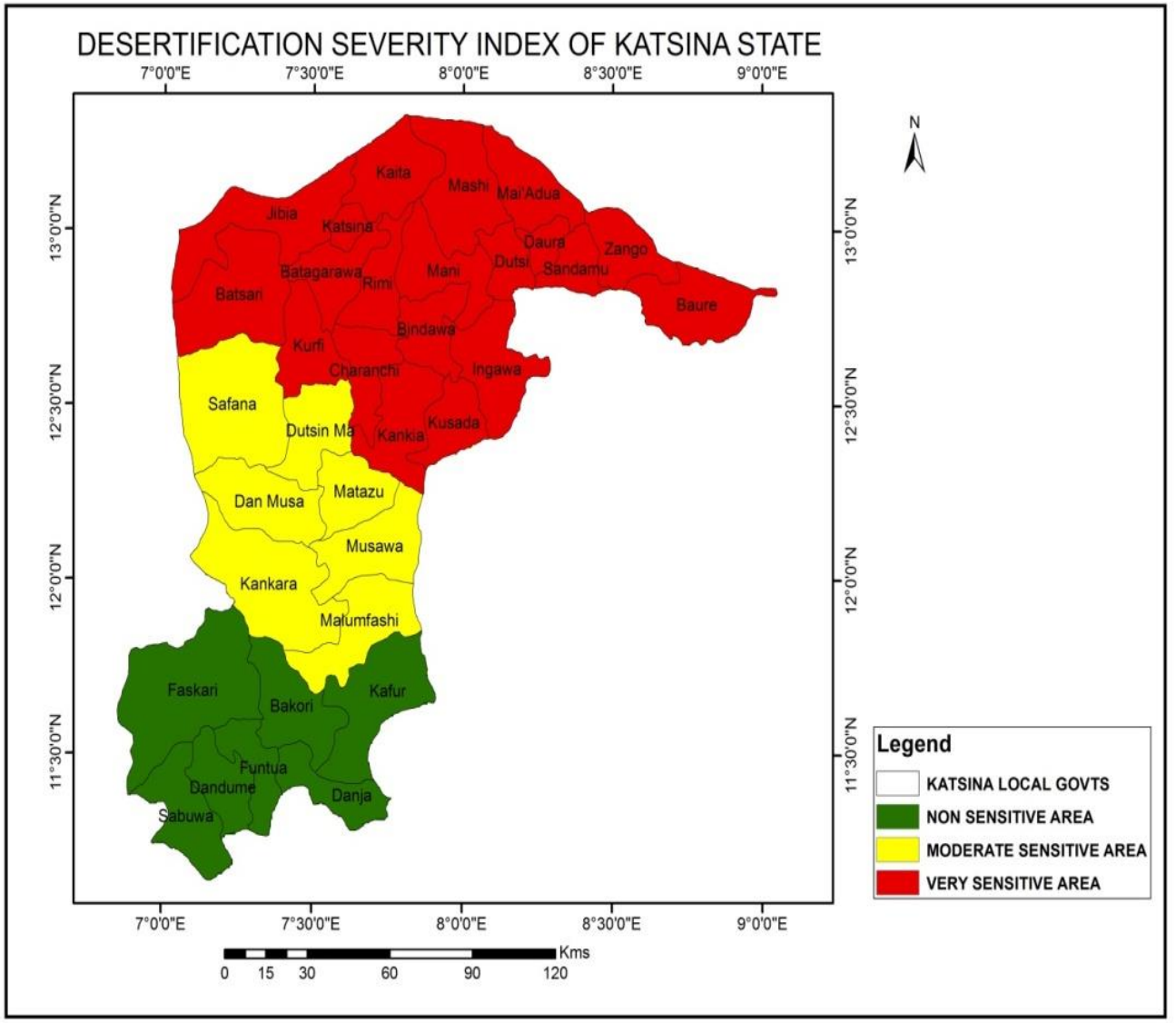
SPACE APPLICATIONS RESEARCH OUTCOMES

Dasymetric Approach To Population Estimation Of Abuja Municipal Area Council Using Nigeriasat-2 High Resolution Satellite Imagery



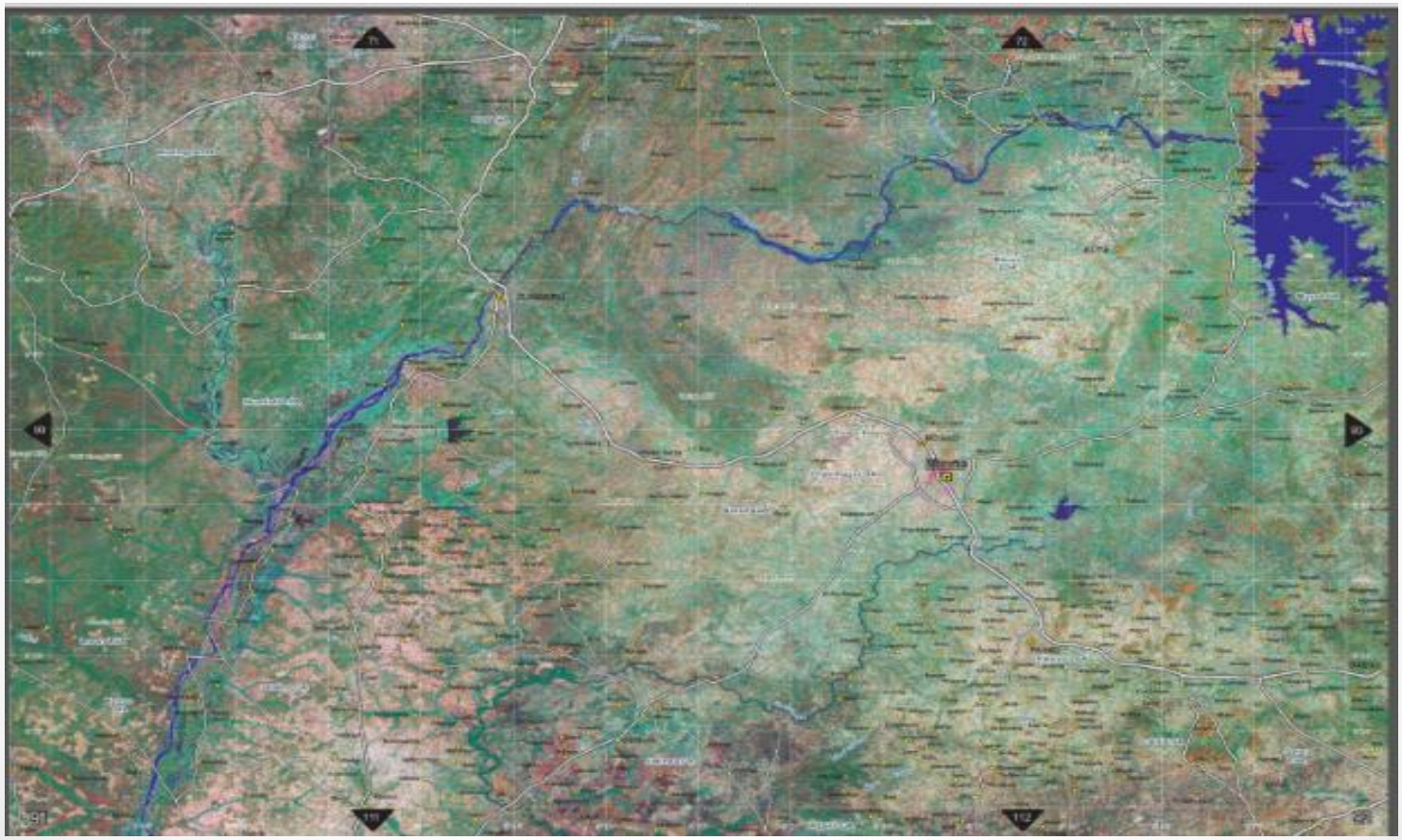
SPACE APPLICATIONS RESEARCH OUTCOMES

Space Based Assessment Of Environmental Sensitivity To Desertification In Katsina State



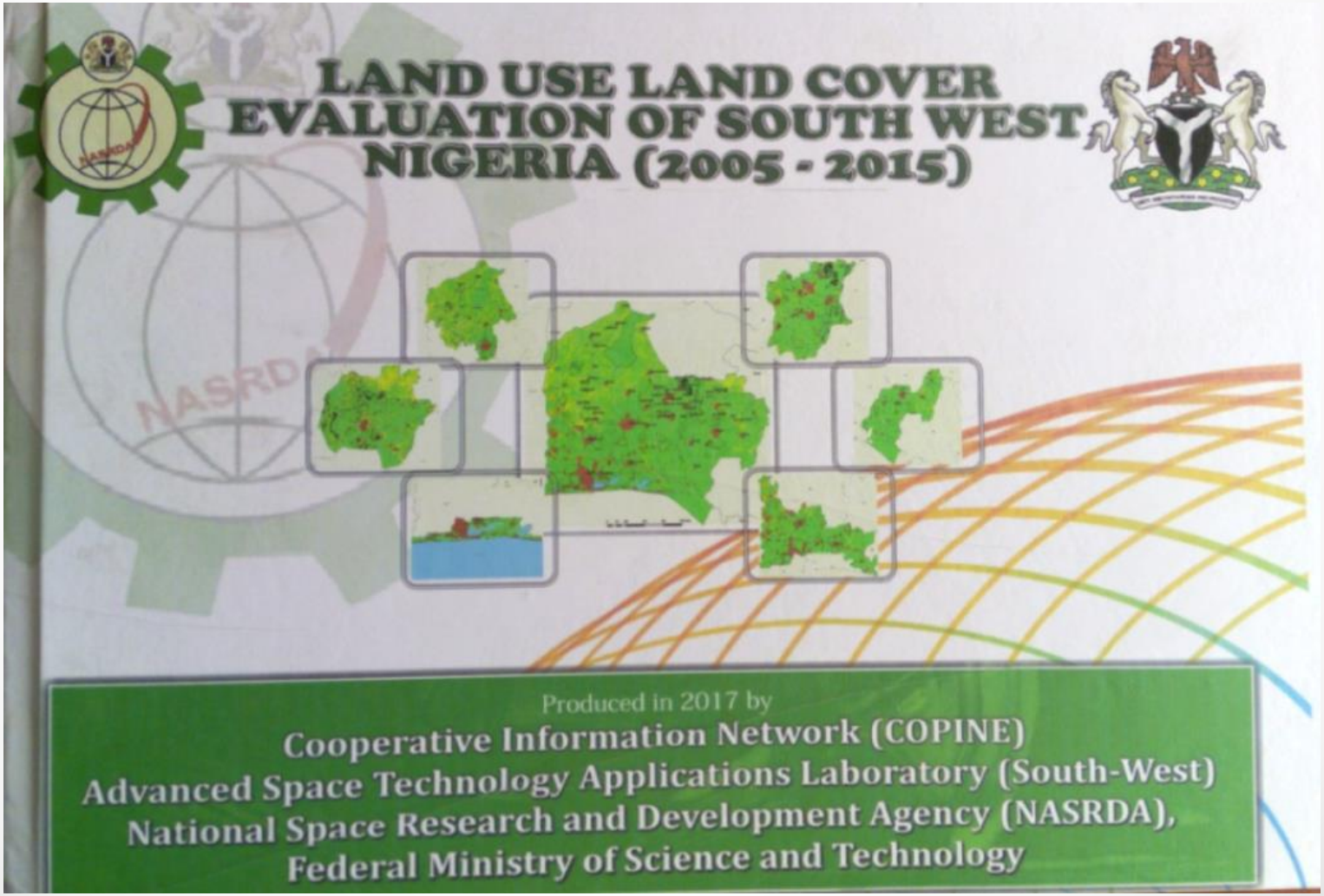
SPACE APPLICATIONS RESEARCH OUTCOMES

Completion of National Satellite Atlas of Nigeria from NigeriaSat-1 Satellite Imagery

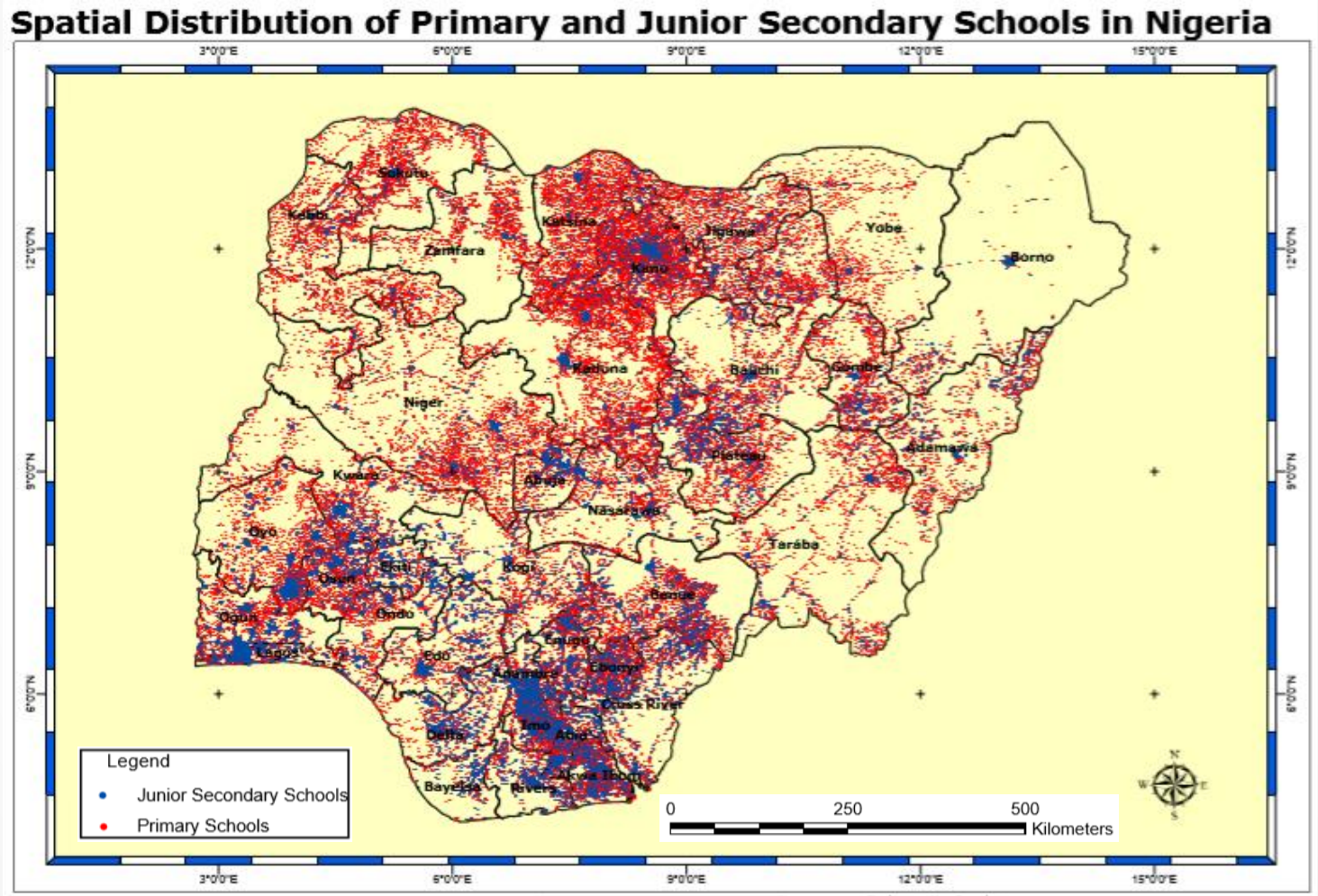


SPACE APPLICATIONS RESEARCH OUTCOMES

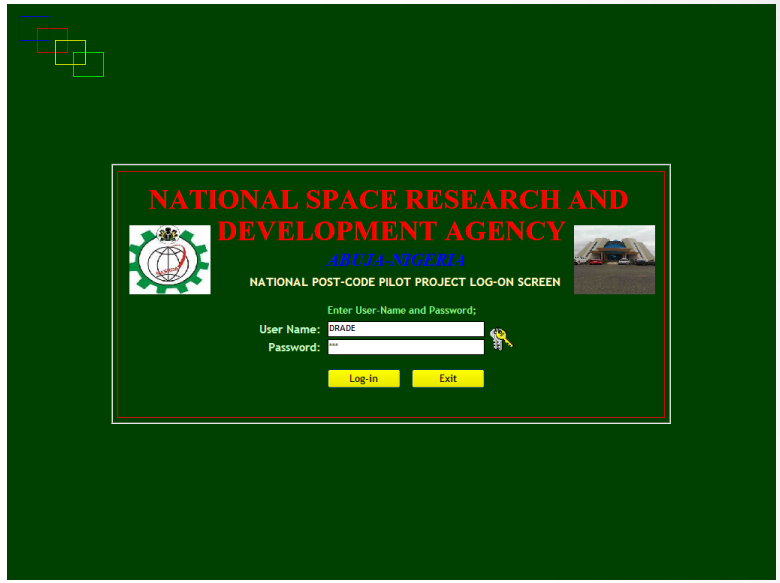
Landuse Landcover evaluation of south west Nigeria(2005-2015)

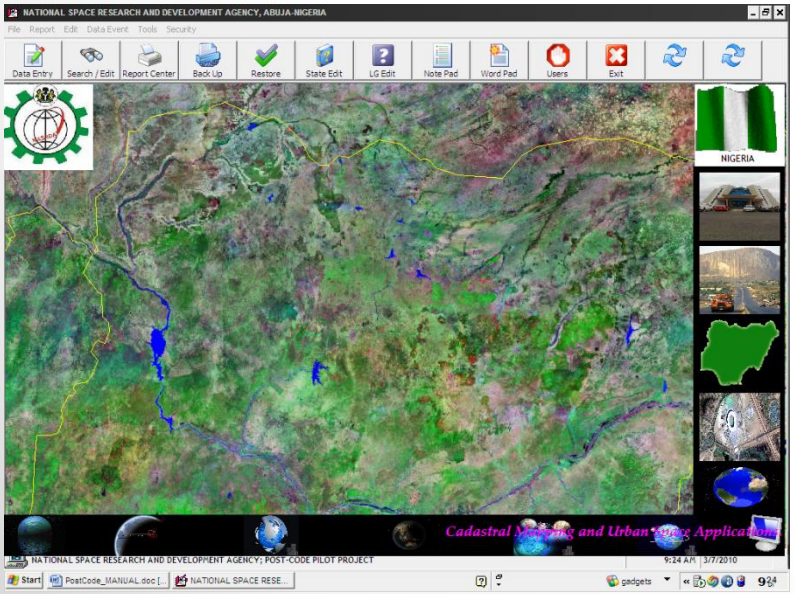


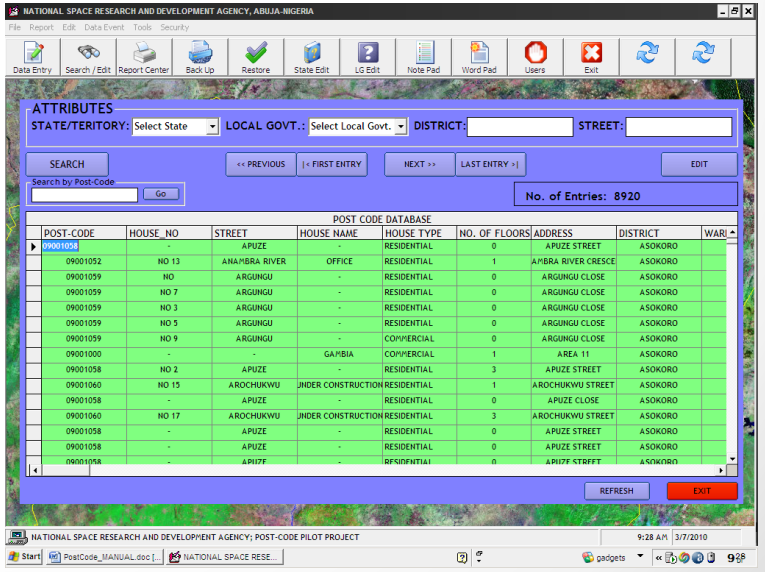
Spatial Distribution of Schools



DIGITAL POST CODE

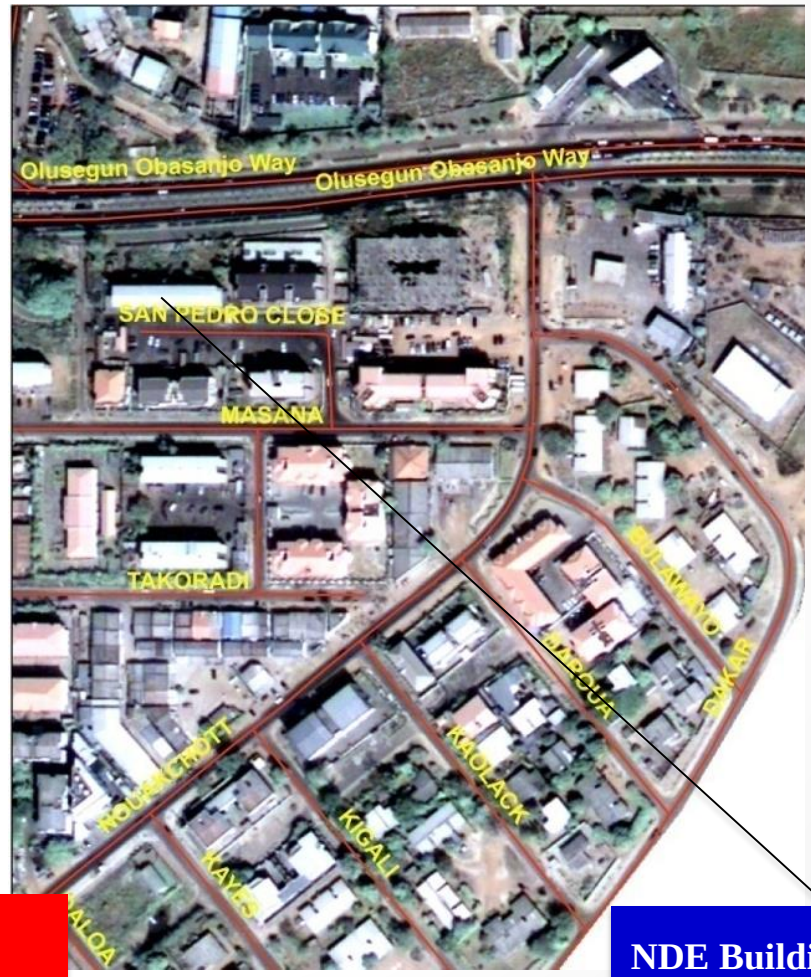






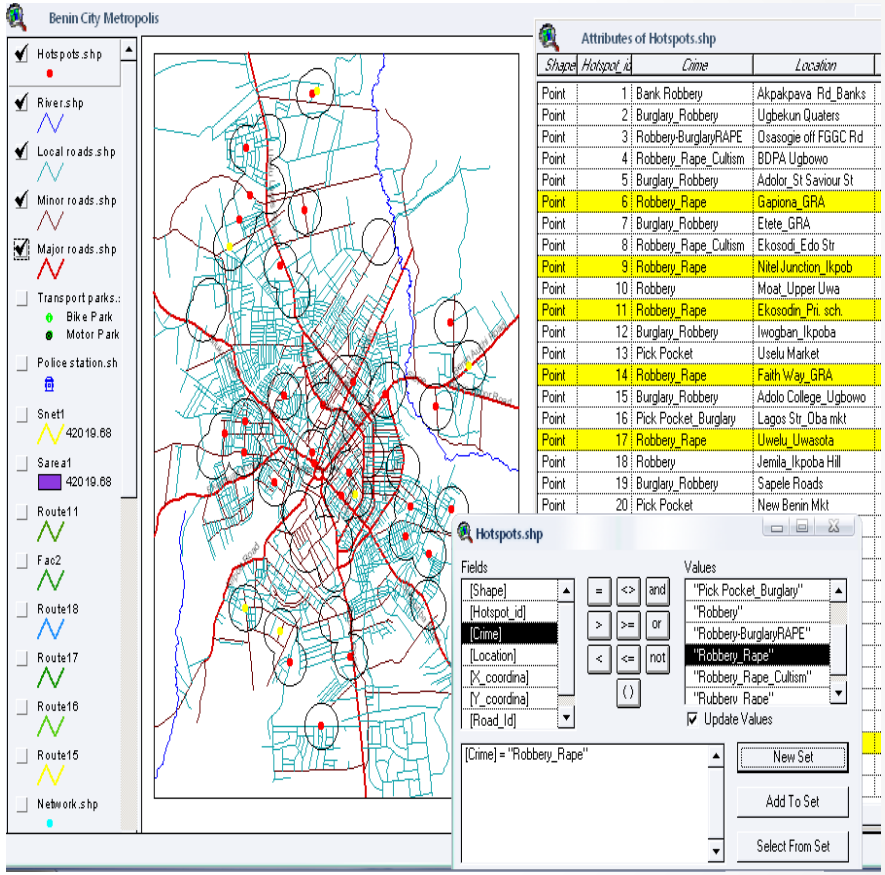
Satellite Image of Postcode zones

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



NDE Building Wuse Zone 2
Post Code: FC3 2AX

SECURITY & Defence - Crime Prevention and Monitoring.



GIS DATA MANIPULATION & QUERY

Planning:

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

Transportation:

- Roads, Railway and Airport Runway Design,
- Aeronautic Charts for Navigation,
- Search and Rescue Operation.

Road Measurement from Satellite Images

SPACE-BASED ASSESSMENT OF GSM COMPLIANCE Cont.

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

- *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 10 Ver. I (Oct. 2014), PP 46-57 www.iosrjournals.org* www.iosrjournals.org 46 | Page
- **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.*

SPIN-OFF

- 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

For Monitoring of Space Weather; Earth Movement

- Embedded Prototyping Kit (EPK)
  - For Computer Aided Control

- In-Car Navigator Pro-43

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

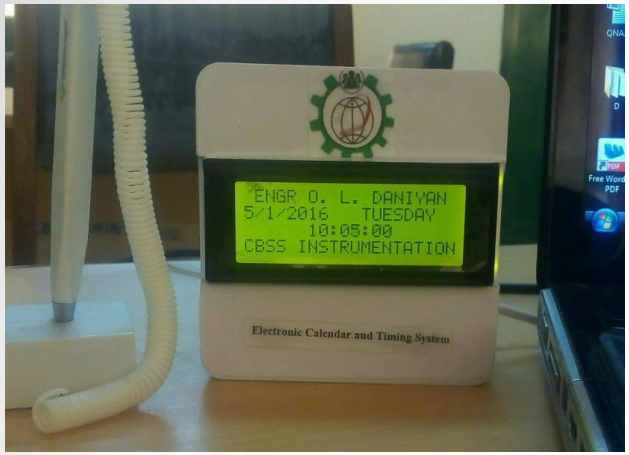
Env. Mon. & Gas Pollution Detector

Range Finder

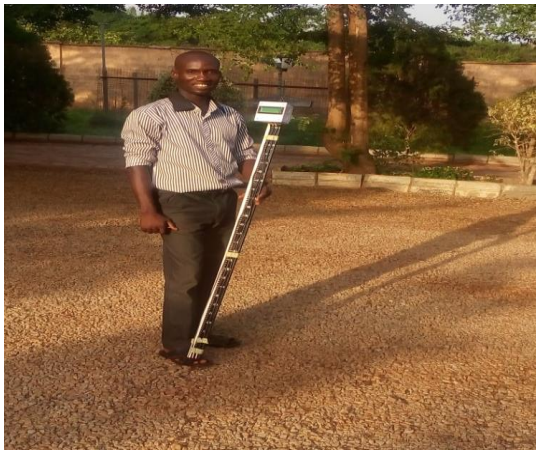
IR non – contact Thermometer

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

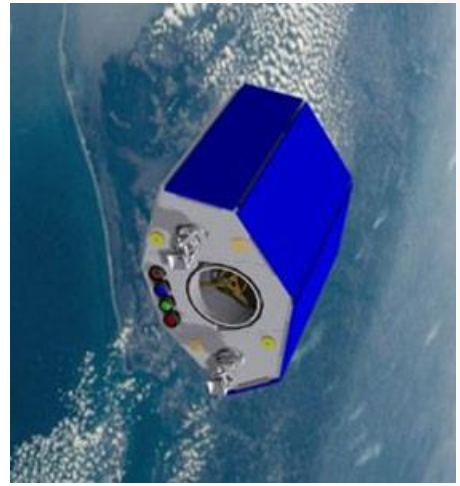
African Union Activities, UN, World Bank

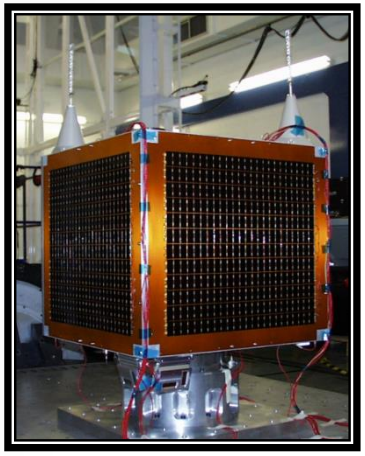
- NASRDA, on behalf of Nigeria is playing a major role in Space Science in Africa.
- NASRDA is a member of the Africa Leadership in Space Conference (ALC).
- The ALC is currently serving in advisory capacity to the African Union Heads of State.
- NASRDA is also a member of the African Resource Monitoring 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 Tehcnology.
- World Bank Erosion Mapping, Deforestation,
- GRID3 (CIESIN Grant)
- GEO, GEOSS, ECOWAS etc.

Conclusion

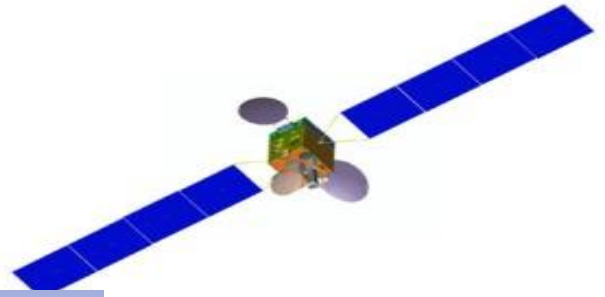
- The Space Programme is only 20 years old.
- Nigeria is the first nation in Africa to establish a Space Agency and today, 15 other African countries have joined.
- So many achievements have been attained during this period.
- The Space Programme remains a strategic vehicle for the achievement of the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

NigeriaSat-2





NigeriaSat-1 and X



NigComSa-1R

THANK YOU