Space Technology Development in Nigeria

by

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Presentation at the:

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"Small Satellite Missions for Scientific and Technological Advancement"
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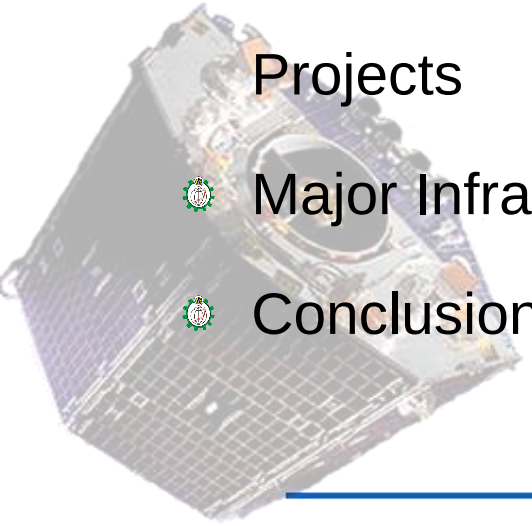
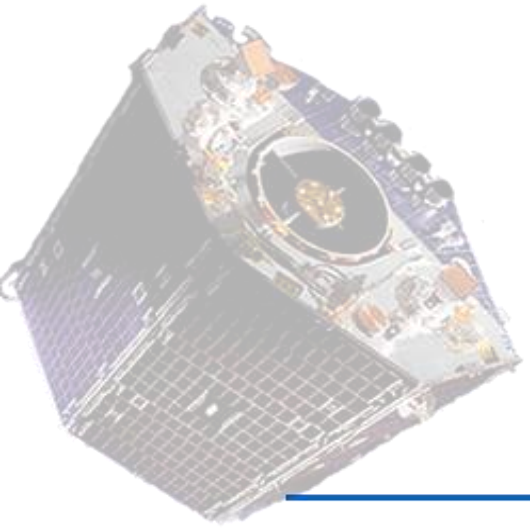
11th -15th December, 2017

OUTLINE

- Historical Perspective of the Nigerian Space Programme
- Nigeria's Space Programme Development Strategy
- Nigeria's Small Satellite Programme
- Capacity Building
- Some Research Outcomes Connected to Small Satellite Projects
- Major Infrastructural Development
- Conclusion



Historical Perspective of the Nigerian Space Programme

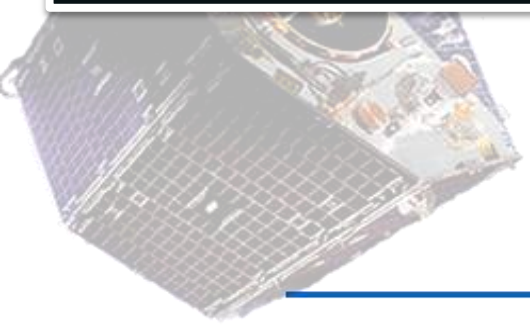


FIRST STEPS TOWARDS A NIGERIAN SPACE PROGRAMME

- In 1976, Nigeria declared its space ambition to members of the Economic Commission for Africa and Organization of African Unity during an inter-governmental meeting in Addis-Ababa.

- In 1988 the National Council of Ministers' approved the establishment of a National Centre for Remote Sensing.

- The National Centre for Remote Sensing, became functional in October 1995.



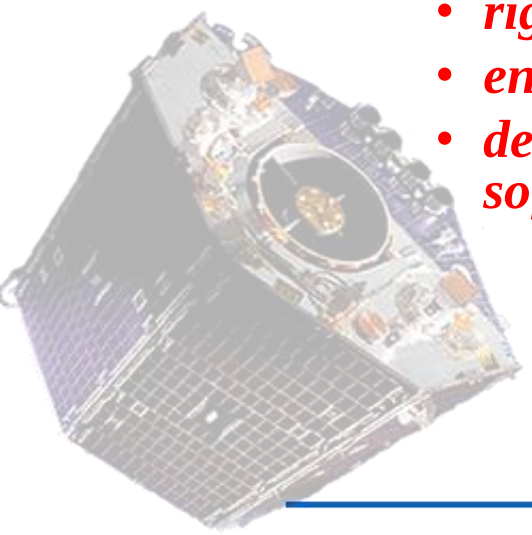
National Space Research and Development Agency:

- NASRDA was established in 1999 with the clear mandate to:

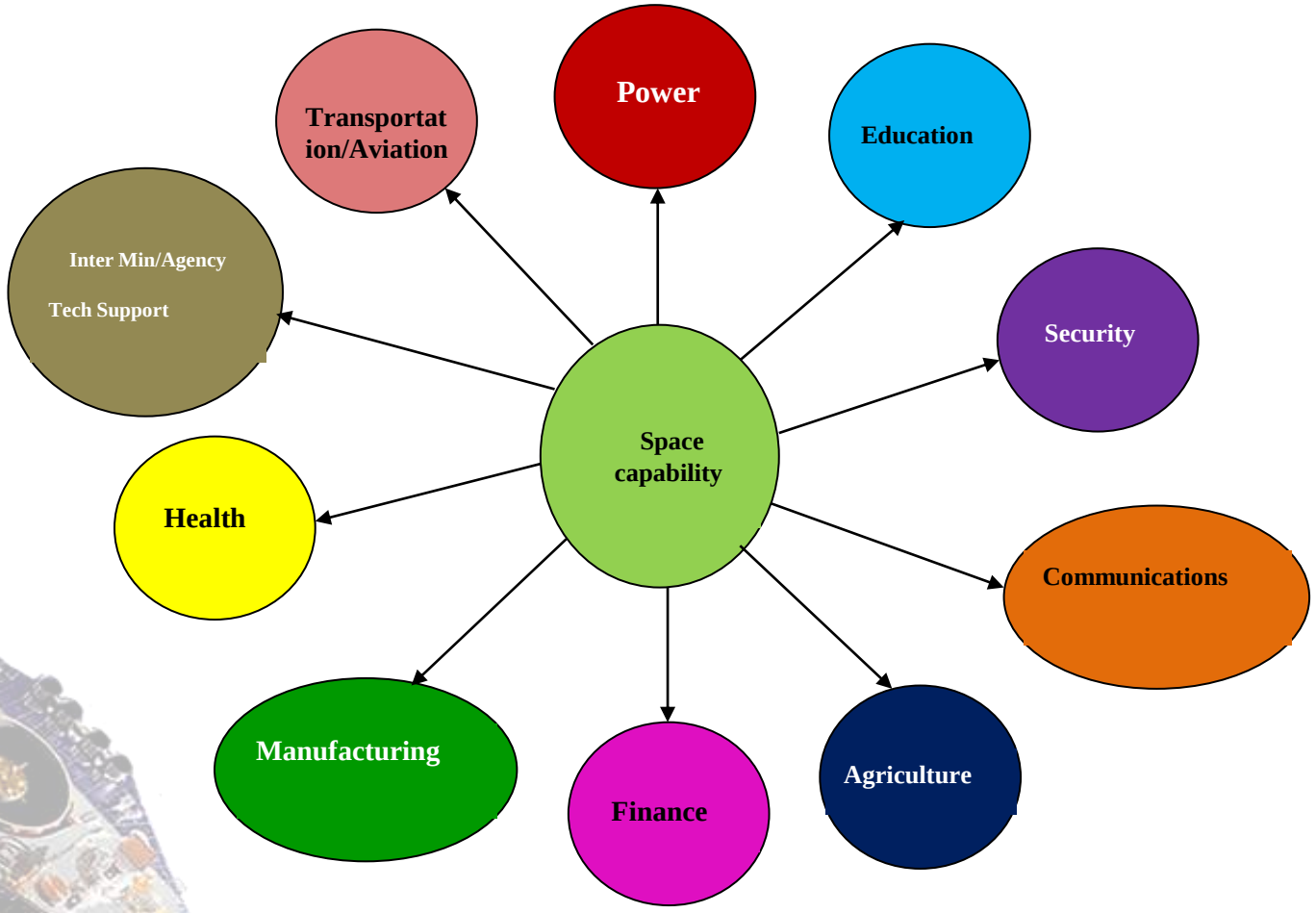
"vigorously pursue the attainment of space capabilities as an essential tool for the socio-economic development and the enhancement of the quality of life of Nigerians".

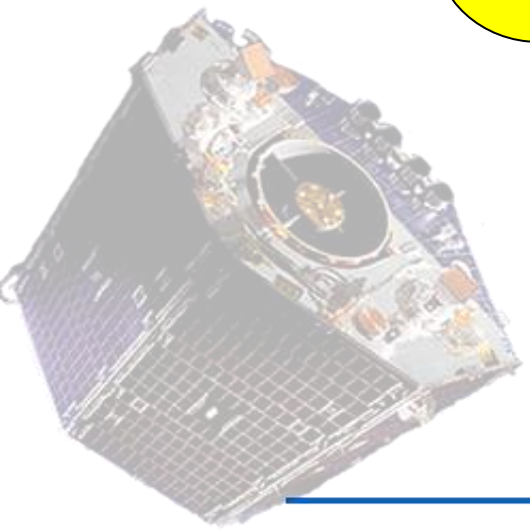
- NASRDA is to achieve this mandate through:

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



National Space Research and Development Agency:





Nigeria's Space Policy/ NASRDA Act

- Approved Space Policy in 2001.

  - ✓ Established the "National Space Council" chaired by Mr. President.
  - ✓ Technical Advisory Committee.
  - ✓ International Cooperation Committee.
  - ✓ Established six Operational Centres

- NASRDA Act signed in to law in 2010.


NASRDA

Thrust of Policy

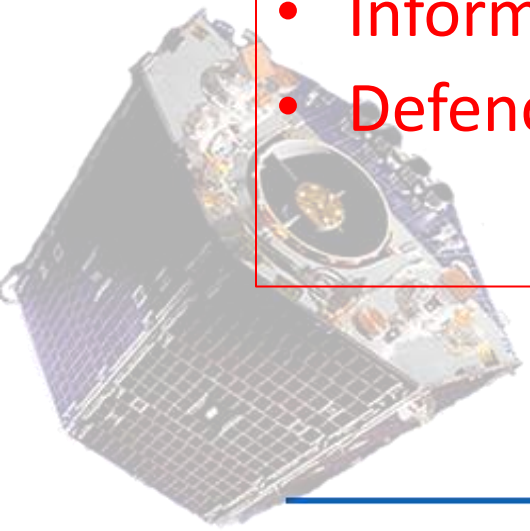
The thrust of the Nigeria Space Policy is the :

- **Development of Human Resources and Capacity.**
- **Natural Resources Management.**
- **Defence, Security, Law Enforcement.**
- **Study of the Earth and its Environment.**
- **Space Communication and Applications.**
- **Education and Training.**
- **Promotion of International Cooperation.**

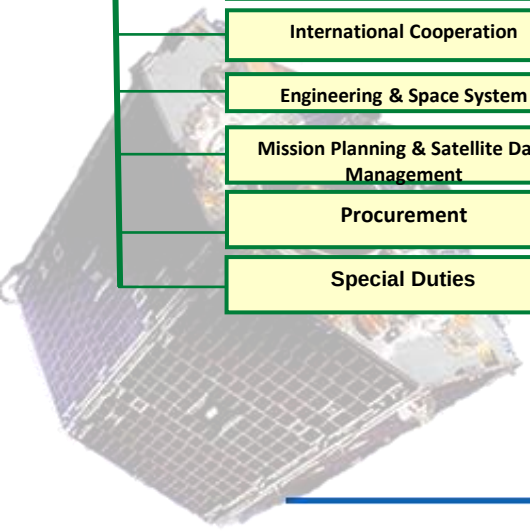
Objective of Policy

Enhance the development of Space Science & Technology, in five major areas:

- Basic Space Science and Technology.
- Remote Sensing.
- Satellite Meteorology.
- Information & Communication Technology.
- Defence and Security.

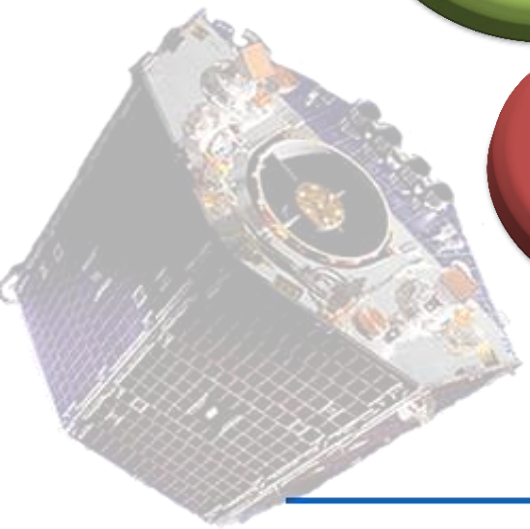


Institutional Arrangement



- NATIONAL SPACE COUNCIL
  - HMST
    - DIRECTOR-GENERAL
      - Technical Advisory Committee (TAC)
      - Transparency & Anti-corruption Unit
      - Audit
      - DEPARTMENTS
        - Administration & Finance
        - Strategic Space Applications
        - Policy Planning & Research
        - International Cooperation
        - Engineering & Space System
        - Mission Planning & Satellite Data Management
        - Procurement
        - Special Duties
      - International Cooperation Committee (ICC)
      - Media, Press & Protocol
      - Council Regulatory Office
      - CENTRES
        - COPINE-Ife
        - Adv. Space Tech. App. Lab. Uyo
        - Adv. Space Tech. App. Lab. Kano
        - UAV Lab. Uturu, Ebonyi
        - Aircraft Engine Lab. Gusau, Zamfara State
        - Aerospace Engines Lab. Oka-Akoko, Ondo State
        - Centre for Basic Space Science, Nsukka
        - Centre for Remote Sensing, Jos
        - Centre for Satellite Technology Development, Abuja
        - Centre for Space Transport & Propulsion, Epe
        - Centre for Space Science and Technology Education, Ile-Ife
        - Centre for Geodesy and Geodynamics, Toro
        - Centre for Lower Atmospheric Research Kogi State University
      - COMPANIES
        - GEOAPPS Plus Nig. Ltd.

NASRDA AND ITS PRESENT OPERATIONAL CENTRES



NIGERIA'S SPACE PROGRAMME DEVELOPMENT STRATEGY

Roadmap For The Nigerian's Space Programme

FEC in 2005 approved a 25 Year Roadmap

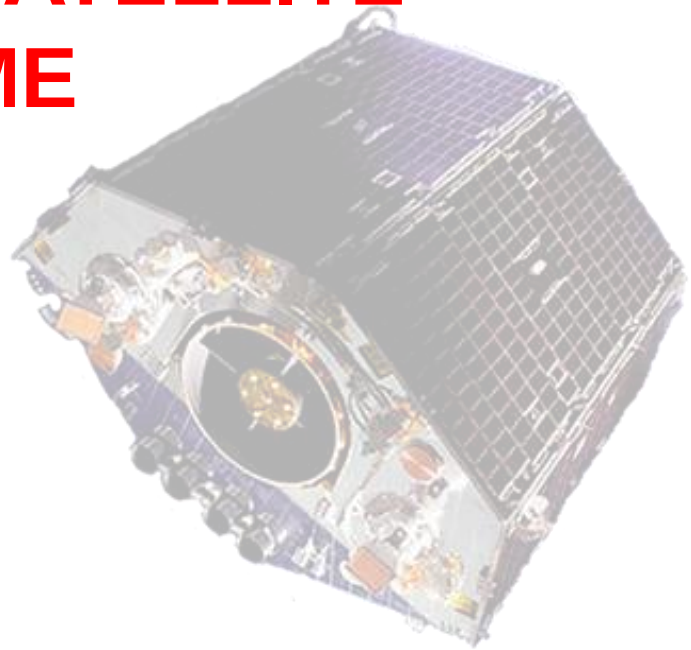
PHASE ONE: 2005 – 2013
PHASE TWO: 2014 – 2022
PHASE THREE: 2023 – 2030

Three Main Goals of the Roadmap:

- ✓ Produce a Nigeria Astronaut
- ✓Launch a satellite manufactured in Nigeria .
- ✓To build and launch a Nigerian made satellite from a launch site in Nigeria on a launch vehicle made in Nigeria .

25-Year Roadmap (2005-2030) Timeline

NIGERIA'S SMALL SATELLITE PROGRAMME



Earth Observation Satellites

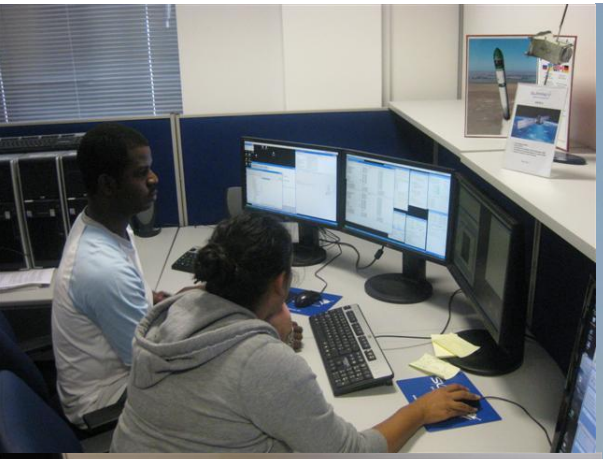
Satellites Launched: NigeriaSat-1 (2003), NigeriaSat-X (2011), NigeriaSat -2 (2011)

Nigeriasat-1

Nigeriasat-X

Nigeriasat-2

NigeriaSat-2 and NigeriaSat-X MCC



Some Major Achievement using NigeriaSat-1

Detailed Resource Inventory of Nigeria	• Scale: 1:100,000 • Saved Nigeria over N2 Billion
Satellite Atlas of Nigeria	• Images used to produce first ever Nigerian Satellite Atlas
Domestication of GIS technology through Collaboration	• 15 GIS / Remote Sensing laboratories established in Nigerian Universities
Donation of Satellite Imageries to Nigerian Universities	• Over 3000 Images donated • Worth over N3 Billion Naira

Achievements using NigeriaSat-2 and NigeriaSat-X

Know How Technology Training	• NX Designed and built by Nigerian Engineers and Scientists • Images currently downloading at the Ground Station in Abuja • Patented Space Technology Knowledge Transferred to Nigerians
Donation of Satellite Imageries to Nigerian Universities / INEC	• NX images to 18 Nigerian Universities for Research • INEC for Delimitation of Constituencies • Worth over N2.5 Billion Naira
Detailed Resource Inventory of Nigeria	• Scale: 1:50,000 • Scale: 1:25,000 for South West of Nigeria • Would save Nigeria about N4 Billion
Support to Armed Forces and National Security	• Images of North-East • Images of Mali for Peace Keeping Operations • Vulnerability Maps of Nigeria Major Cities

Topographic Map Of South West Mali Produced for the Intervention in Mali

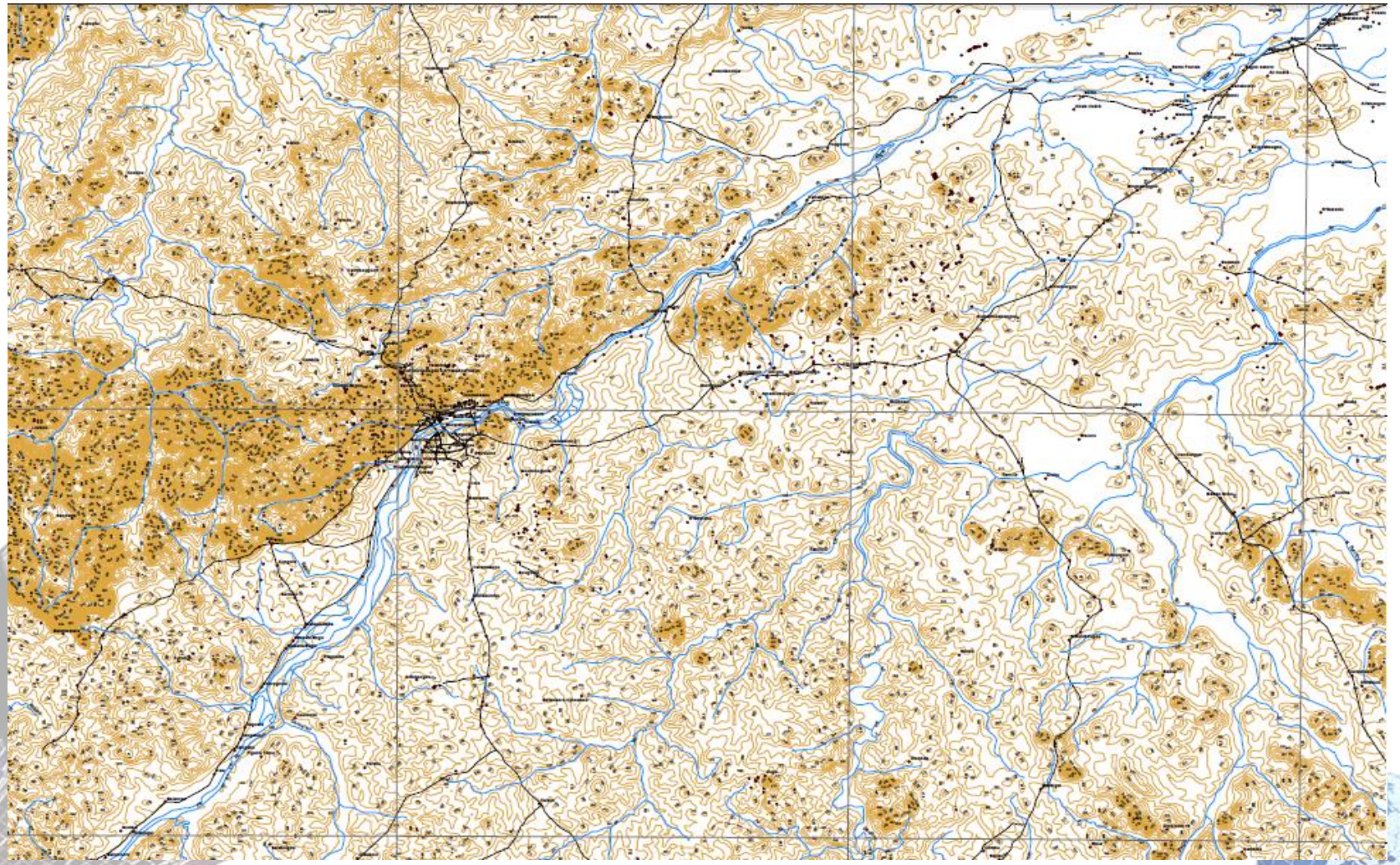
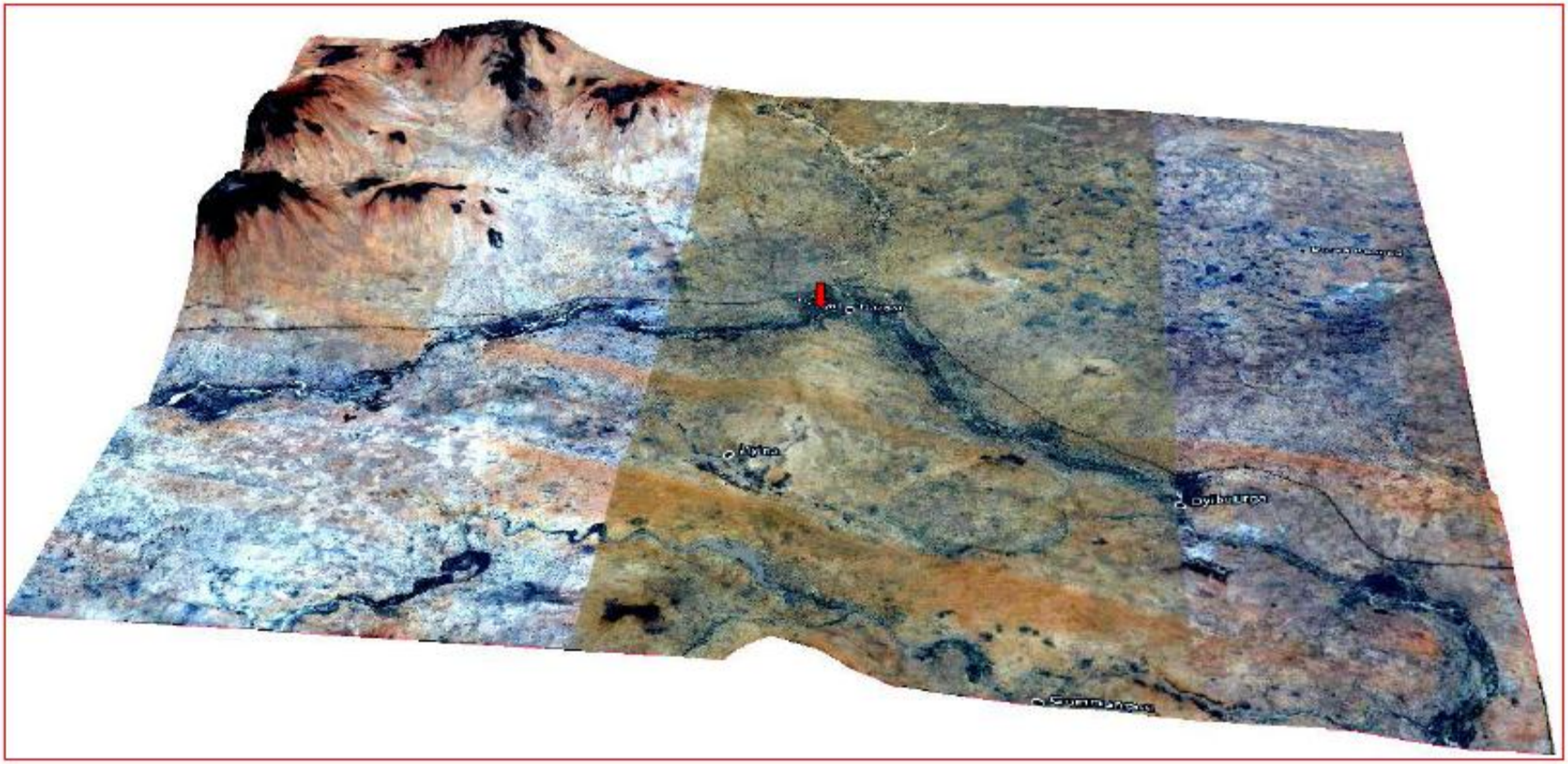


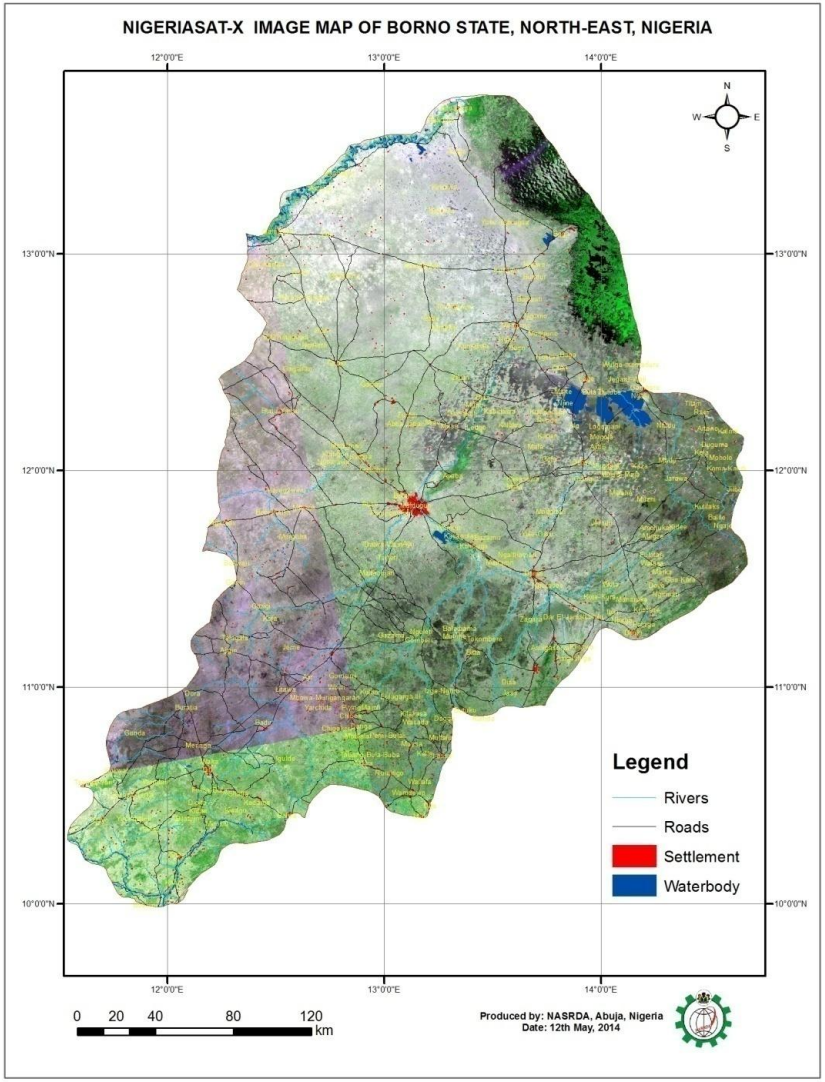
Image mapping and Terrain Analysis of Dargol Area, Niger Republic [Scene of Nigerian Airforce Jet Crash in Niger Republic] using Nigeriasat-2 data

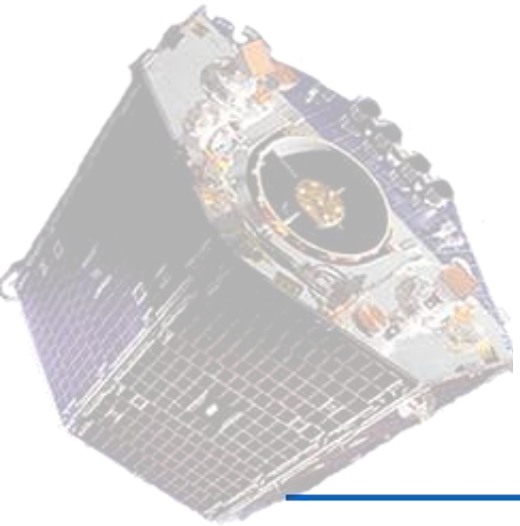
Digital Terrain Model of Dargol Area, Niger Republic



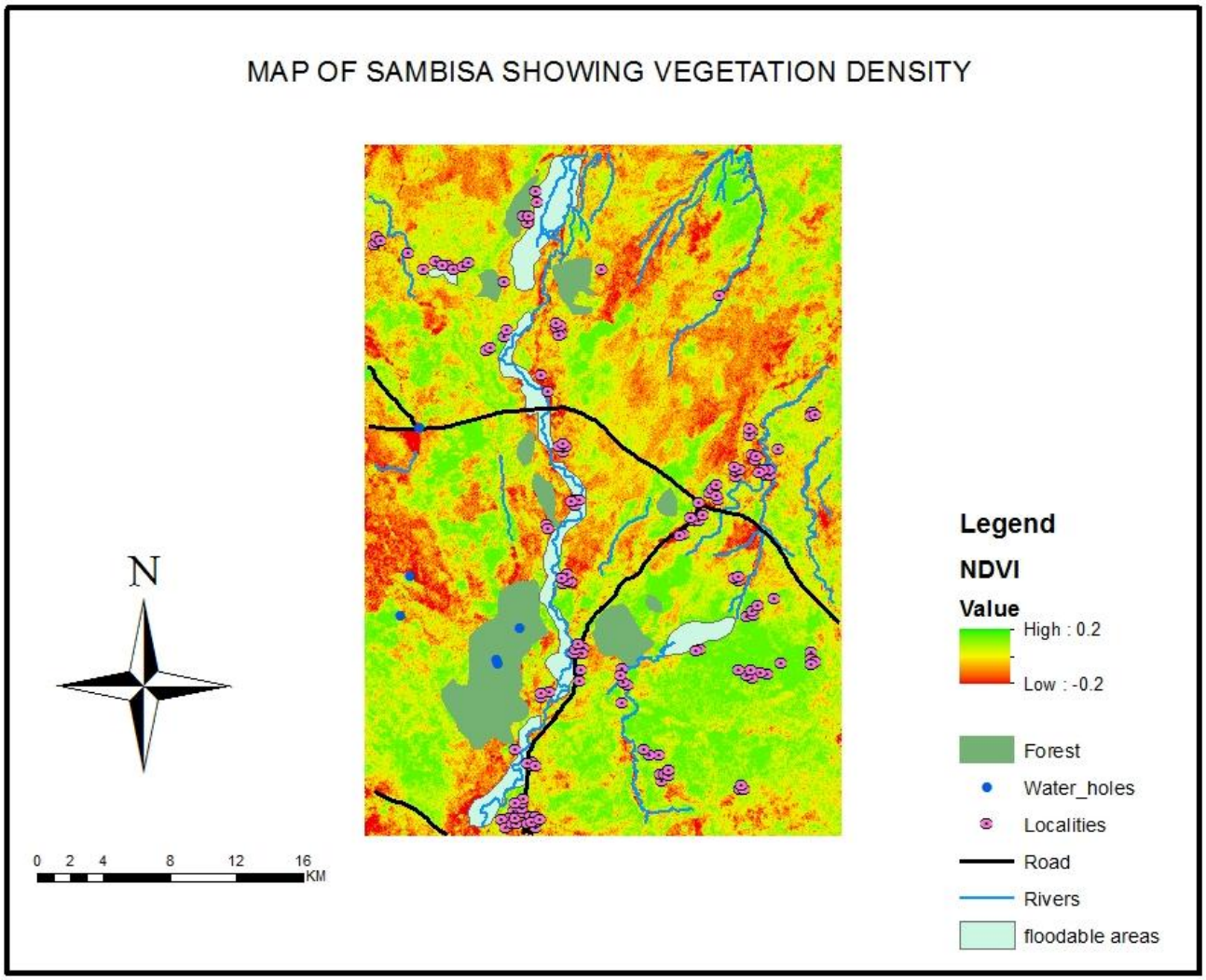
Produced by: NASRDA, Abuja
Date: 18th July, 2013

Image Map of Borno State from NX

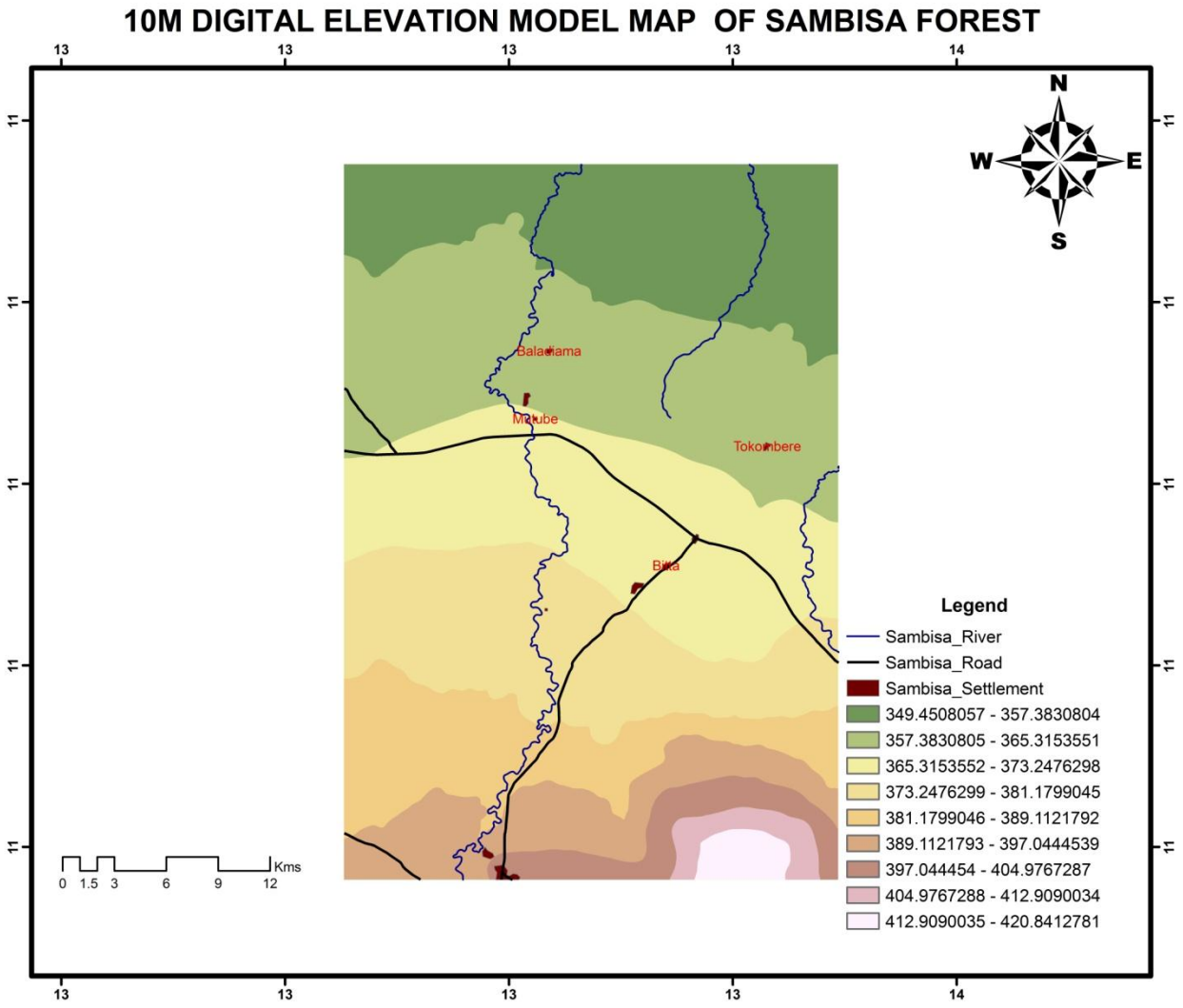




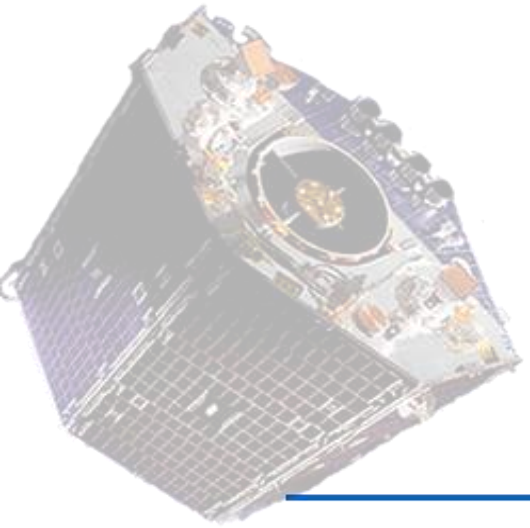
Vegetation Density Map of Sambisa Forest from NX



Digital Elevation Model for Sambisa Forest



Capacity Building

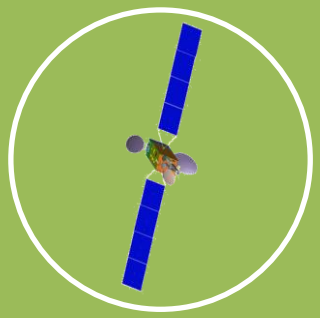


Capacity Building

Know How Technology Training

NigeriaSat -1

- 15 Engineers



NigComSat-1

- 55 Engineers

NigeriaSat-2

- 27 Engineers
- 10 M.Sc. Awarded by University of Surrey

NIGERIASAT-X designed & built by Nigerian Engineers using SSTL Facilities

Capacity Building

Know How Technology Training

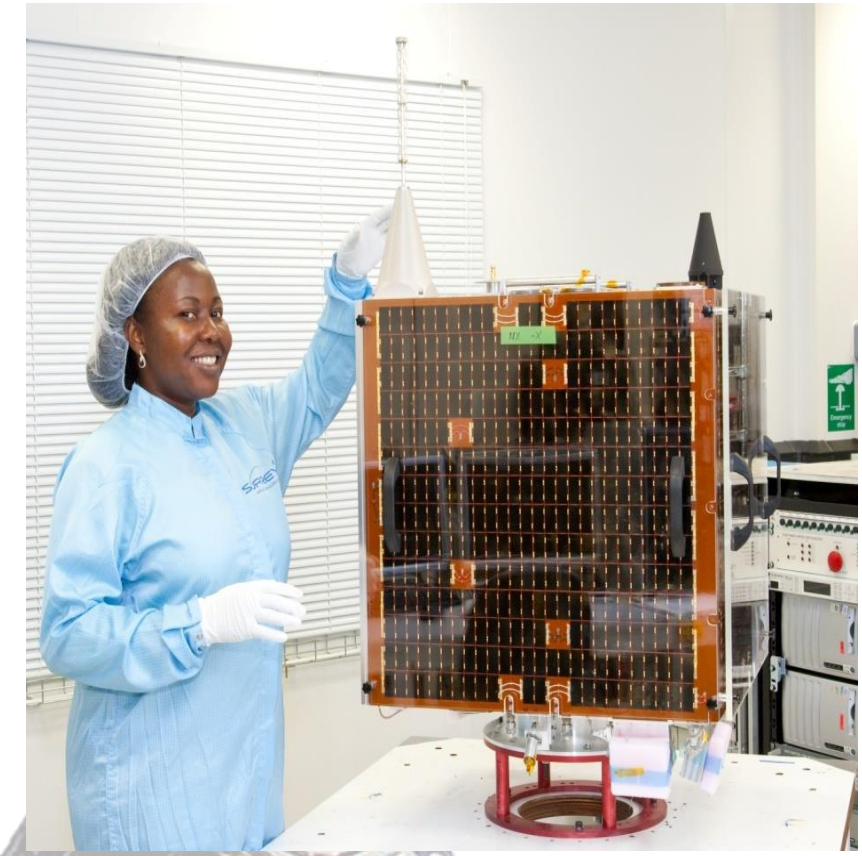
NIGERIASAT-2 (Nigerian Engineers @ work using SSTL Facilities)

Capacity Building

NX Engineers

Capacity Building

Know How Technology Training



NIGERIASAT-X designed & built by Nigerian Engineers using SSTL Facilities

Capacity Building

Know How Technology Training

Nigeriasat-X designed & built by Nigerian Engineers using SSTL Facilities

Nano Satellite: Nigeria Edusat-1

- The programme consists of 5 CubeSats belonging to:
  - Japan,
  - Nigeria,
  - Ghana,
  - Mongolia and
  - Bangladesh
- Space X Falcon9 Rocket launched the satellites from Kennedy Space Centre in Florida, USA on June 6th 2017

- The Satellites were deployed into lower orbit (460km) from the ISS on the 7th of July 2017 .
- Satellites are for capacity building.
- Owned by NASRDA in collaboration with Federal University of Technology, Akure.
- The programme was introduced by the Japanese government and implemented by the Japanese Space Agency through the Kyushu Institute of Technology.

Nano Satellite: Nigeria Edusat-1

The Ground Station

- One of the Ground Station for the Satellite developed at NASRDA.
- The Ground Station Equipment include:
  - **C**ross Yagi-Uda antennas (2m and 70cm), Icom Transceiver,
  - Yeasu Antenna Rotator, PC with Satellite tracking software.
- The Antenna development completed by NASRDA Engineers/Scientists.
- The programme is focused on engaging students and general public in space exploration, satellite technology and satellite communications, thereby strengthening the human resource development required for the implementation of the national space programmes

Ground Station Antenna during Testing Phase

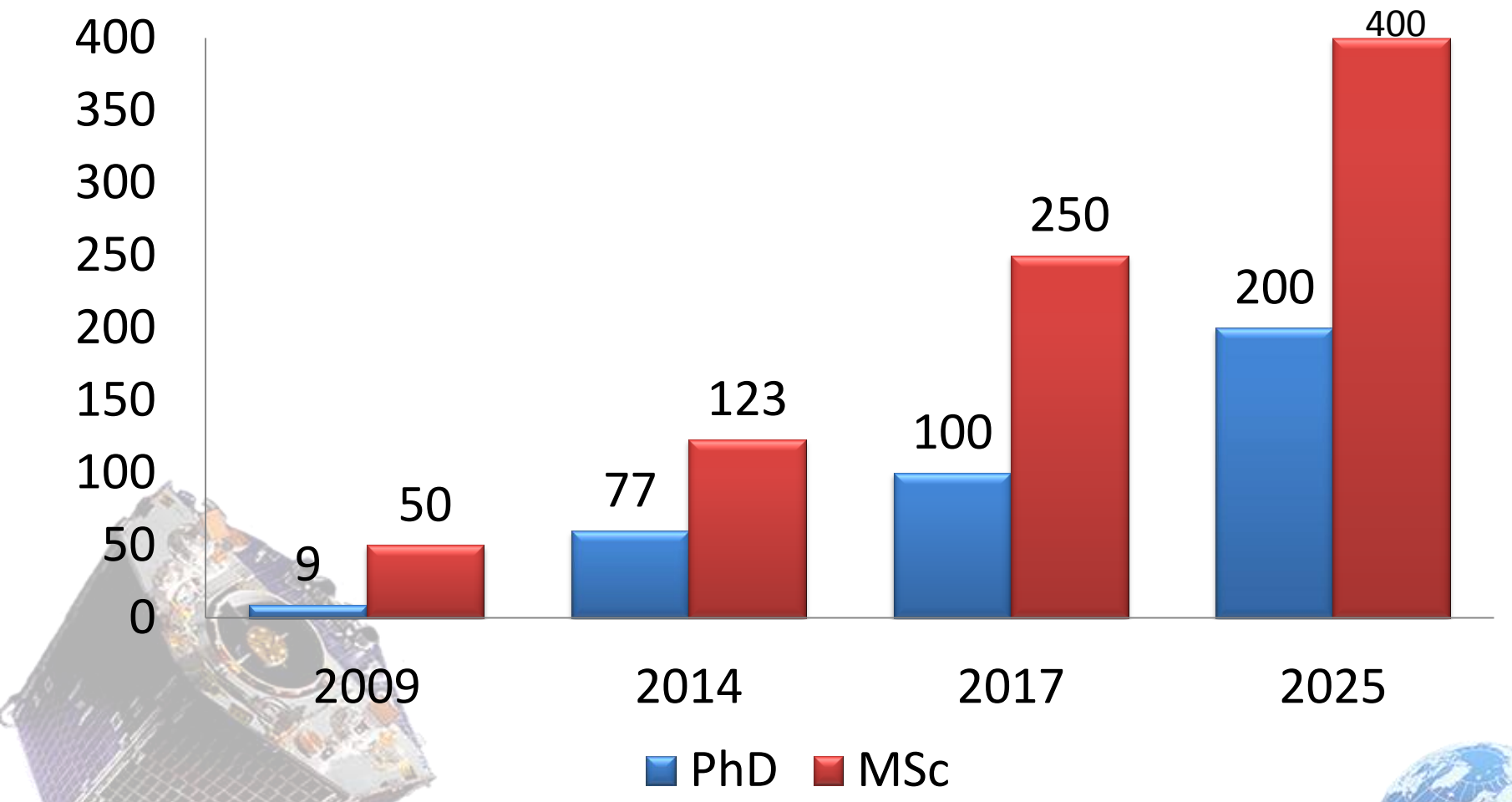
NASRDA engineer installing the Ground Station Antenna

Capacity Building

Establishment of Institute of Space Science and Engineering (ISSE)

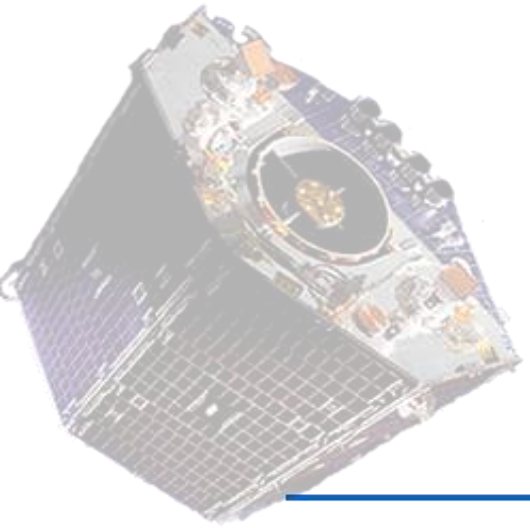
- The Institute of Space Sciences & Engineering (ISSE) was established in Abuja on 2nd June, 2015 in accordance with (NASRDA) Act 2010.
- It is a unique postgraduate Institute set to address the growing needs of Space scientific knowledge and innovations in Nigeria and Africa continent at large.
- The Institute is a collaborative project with the African University of Science and Technology.
- ISSE will offer programmes leading to the award of MSc and PhD.
- The first set of students expected in 2018.

Capacity Building



Total Number of Publications (Journals, Proceedings & In-review) is over 500

Some Research Outcomes Connected To Small Satellite Projects



NAVIGATOR PRO43-Completed

- It provides complete and clear voice instructions, which makes navigation easier. It is simple and understandable.
- It pronounces street names during navigation, making your drive easy.
- The NASRDA Pro43 offers you a unique new navigation experience.
- NASRDA Navigator Pro43 provides you with the EXCLUSIVE SATELLITE views, display your current location, and it is a high resolution touch screen.

Cubesat Structure : Ongoing

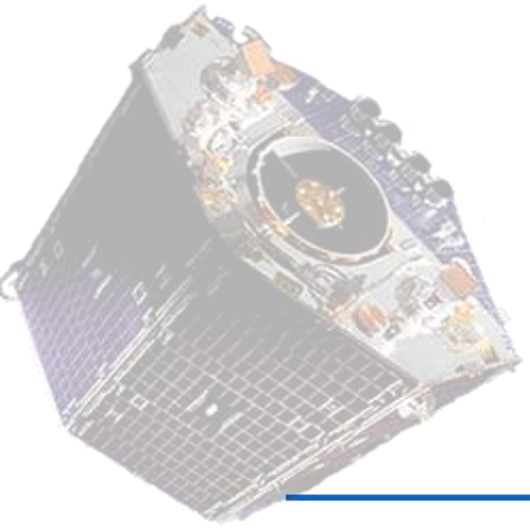
- Design & Fabrication of *"An Experimental Model of Cubesat Structure And Various Components".*
- Develop Fabrication Capacity

ENGINEERING RESEARCH OUTPUTS

For Monitoring of Space Weather; Earth Movement

Embedded Prototyping Kit (EPK)

- For Computer Aided Control

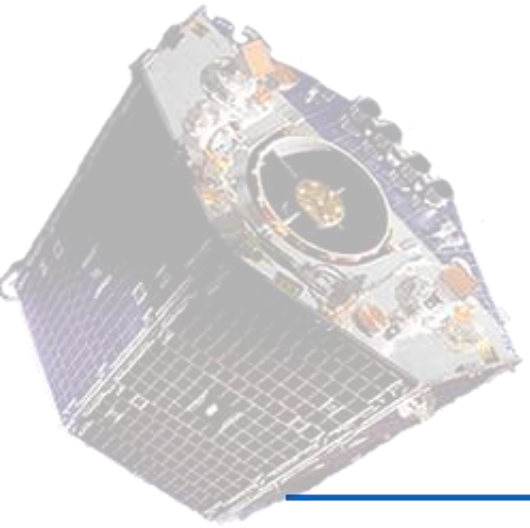


ENGINEERING RESEARCH OUTPUTS

Environmental pollution and Soil Monitoring (EPSM)Station

Portable stand – alone wireless surveillance system

High Precision GPS System



ENGINEERING RESEARCH OUTPUTS

AUTOMATED LAUNCH CONTROL SYSTEM: Completed

System Specification

- Remote control of Mechanical System
- Rocket Launch and Hydraulic Automation
- Remotely operated ignition system
- Developed by NASRDA Scientists and Engineers
- Microcontroller based system

APPLICATION AREAS:

Launch and control of Rocket System, Mechanical System and Autonomous Control Mechatronics.

SPACE APPLICATIONS RESEARCH OUTCOMES

Gully Erosion Mapping in South Eastern Nigeria

EROSION SITE IN ANAMBRA STATE

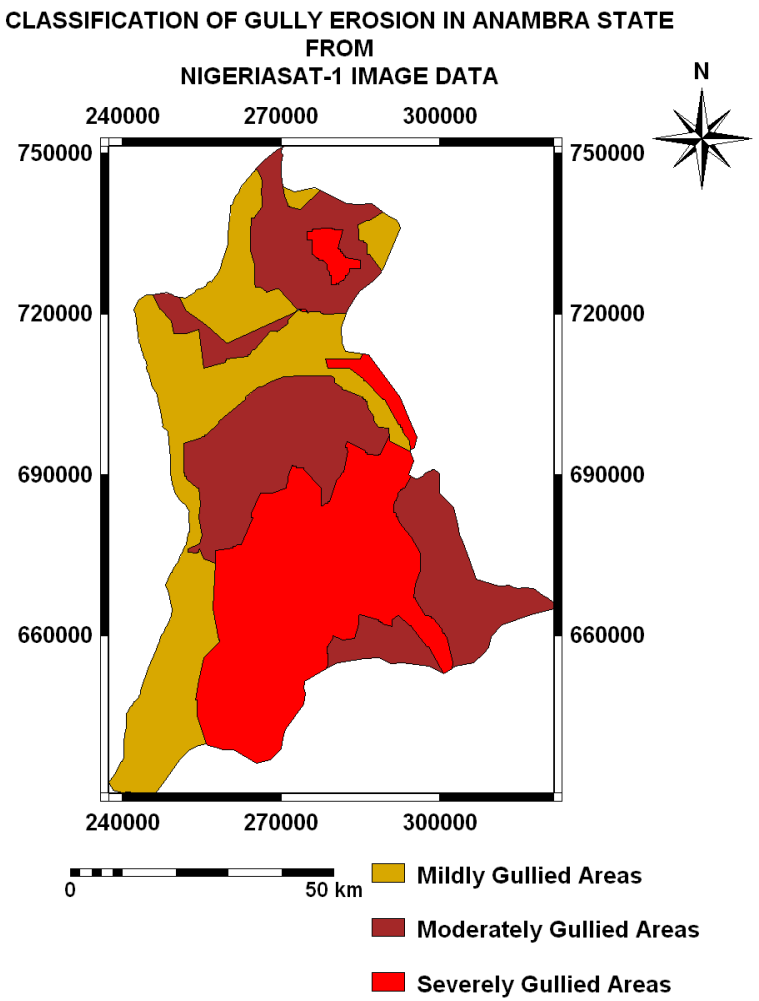
EROSION SITE IN ABIA STATE

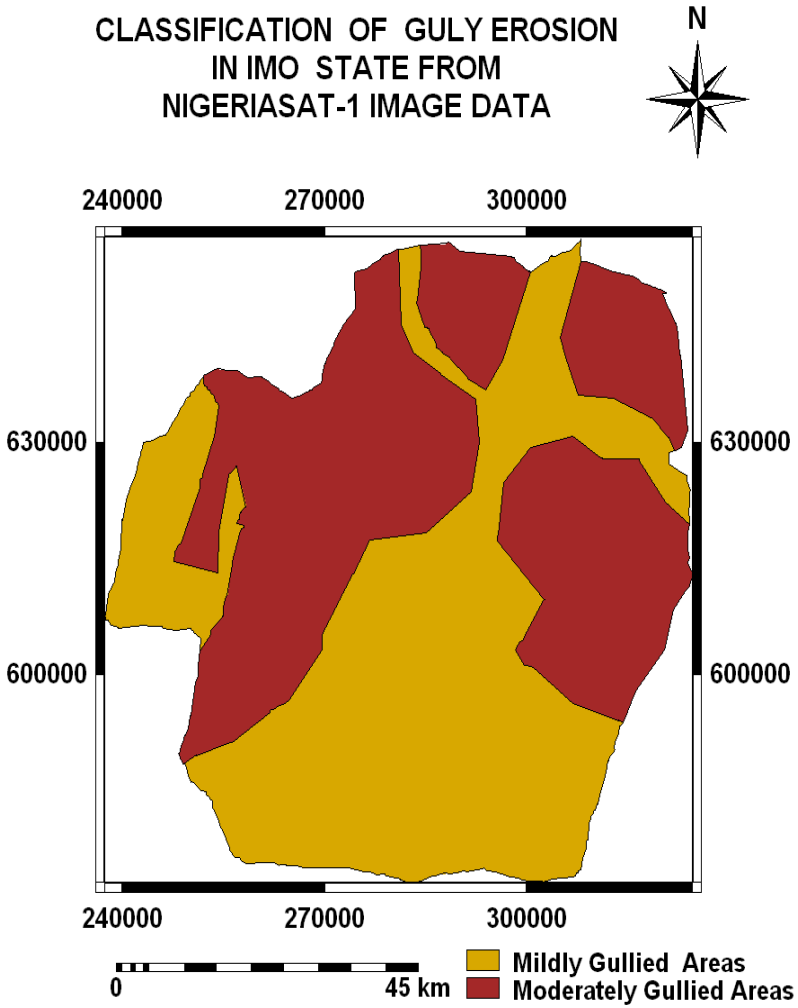
EROSION SITE IN IMO STATE

EROSION SITE IN ENUGU STATE

SPACE APPLICATIONS RESEARCH OUTCOMES

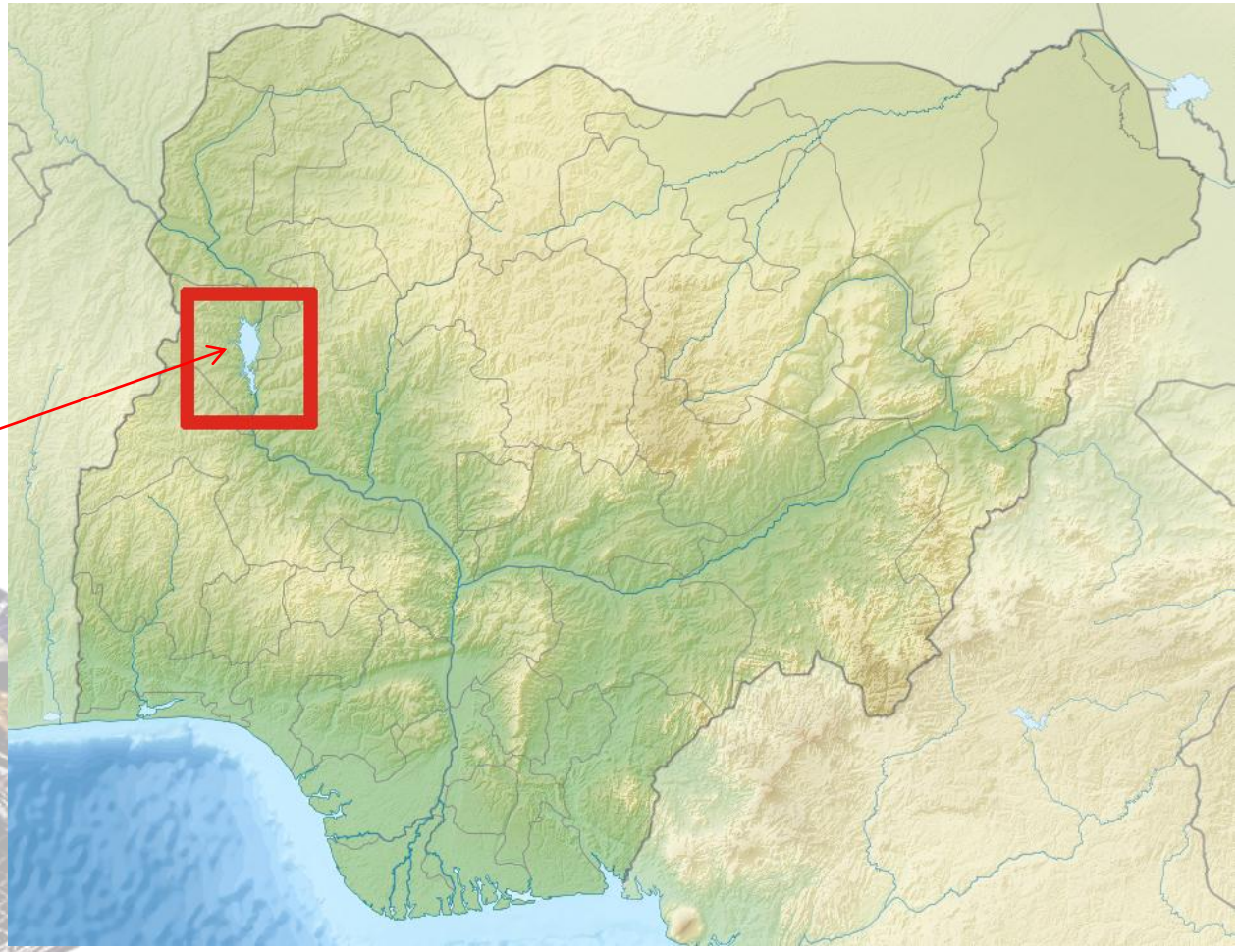
Classification of Gully Erosion in some States in Nigeria





SPACE APPLICATIONS RESEARCH OUTCOMES

Flood Hazard Mapping of the Kainji Lake



Map of Nigeria showing the Kainji lake

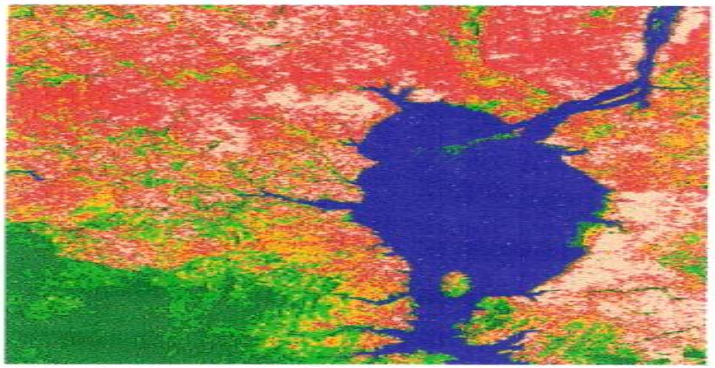
SPACE APPLICATIONS RESEARCH OUTCOMES

Flood Hazard Mapping of the Kainji Lake

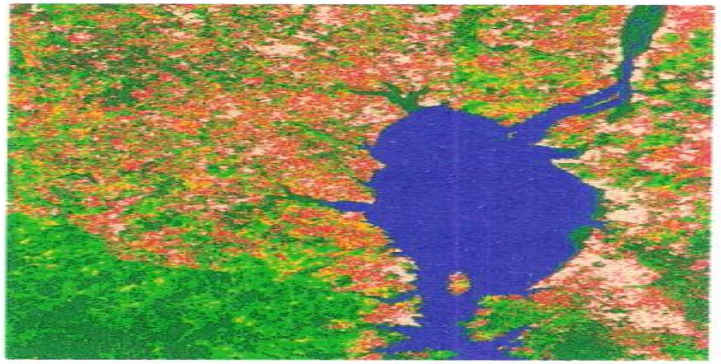
SPACE APPLICATIONS RESEARCH OUTCOMES

Flood Hazard Mapping of the Kainji Lake

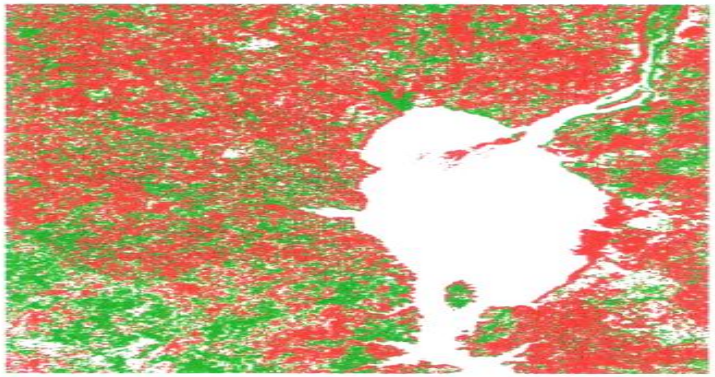
Land cover maps from NigeriaSat-1 and Landsat Satellite Images



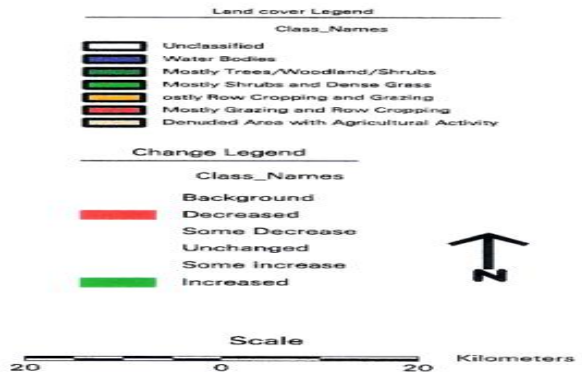
(Landcover map from NigeriaSat-1(2004)



Land cover map from Landsat (2000)



Land cover change map (2000 - 2004)

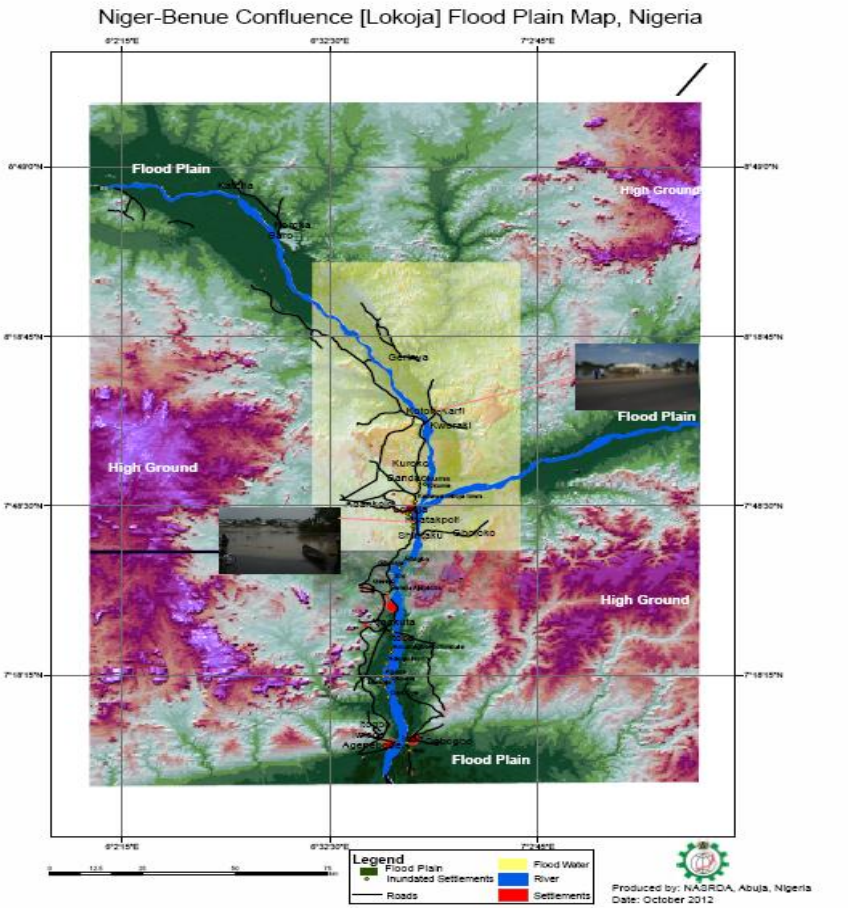


Federal Government of Nigeria
Federal University of Technology, Minna in collaboration with National Space Research and Development Agency (NASRDA), Abuja

SPACE APPLICATIONS RESEARCH OUTCOMES

Response to Flood In Lokoja in 2012

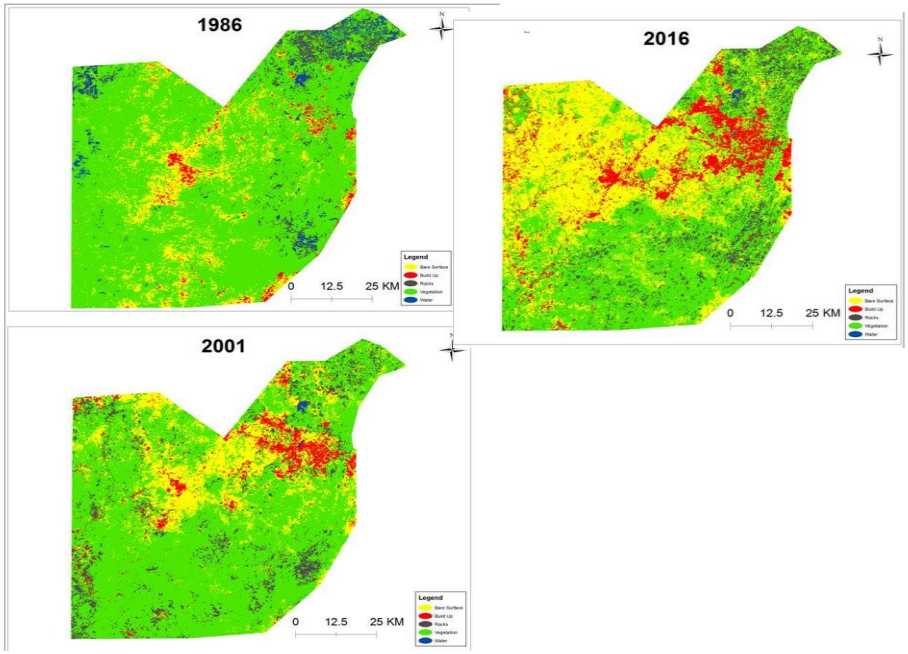
- Lokoja was one of the flooded areas during the 2012 flood
- NASRDA visited the flood area and produced a flood plain and vulnerability map for the affected areas.
- The map was used by NEMA to rehabilitate those affected by the flood.



SPACE APPLICATIONS RESEARCH OUTCOMES

Natural Resource Inventory of the FCT F\for Sustainable Development

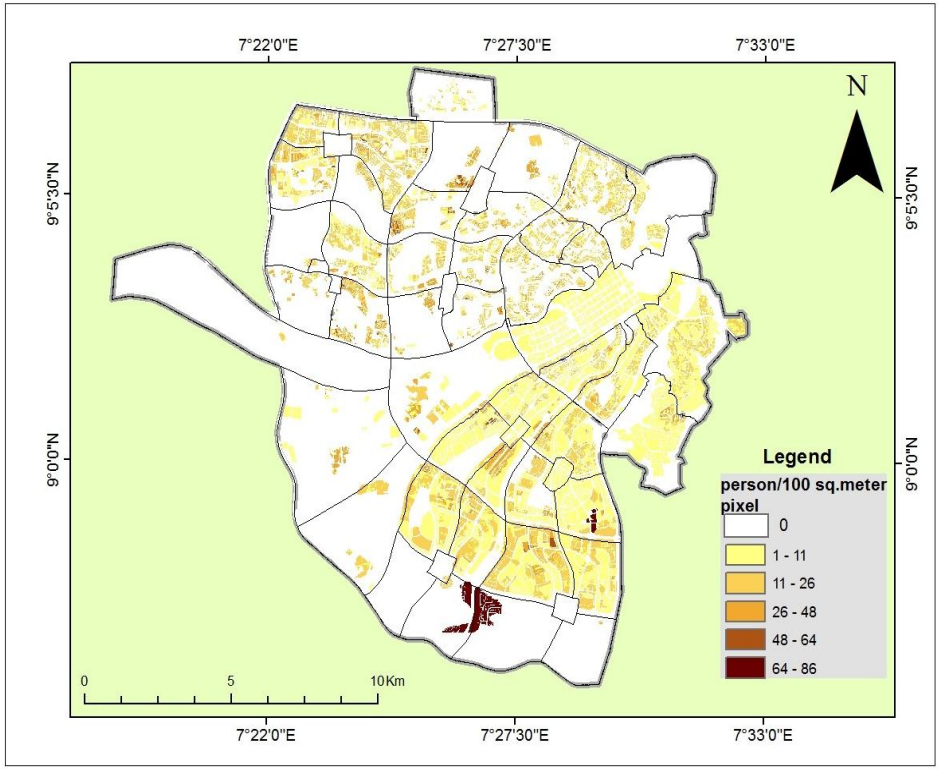
- Over the past three decades the FCT has recorded a tremendous decrease in vegetal cover.
- The proportion of vegetal cover records of 1986, 2001 and 2016 are 79.5%, 69.4% and 47.3% respectively.
- The major landuse changes are vegetation to bare surface, vegetation to buildup and bare surface to vegetation.
- Human activities such as clearing of land for agriculture and infrastructures coupled with an unprecedented increase in the build up areas has led to enormous depletion of the vegetal cover in FCT.



SPACE APPLICATIONS RESEARCH OUTCOMES

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

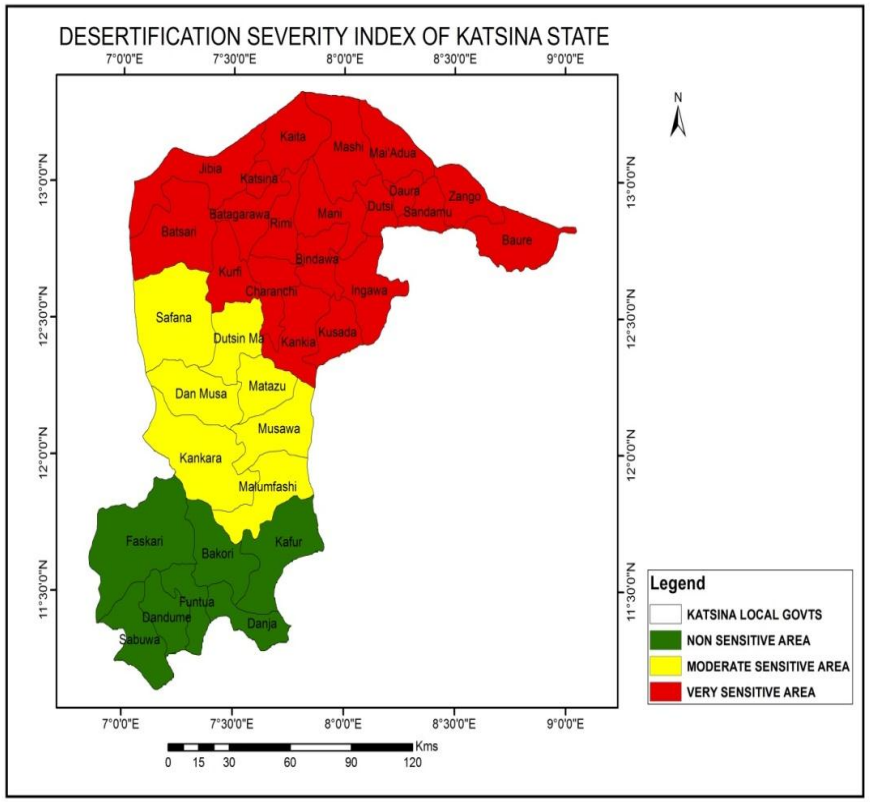
- The National Population Census will soon be conducted.
- NASRDA is currently using dysemetric approach to estimate the population distribution using FCT as sample area.
- The dysemetric methods revealed the variation in population density more realistically across the FCT(Phases 1-3).
- This information will go a long way to aid policy/decision makers in allocating resources appropriately to the citizenry.
- This will also serve as input into the forthcoming National Census.



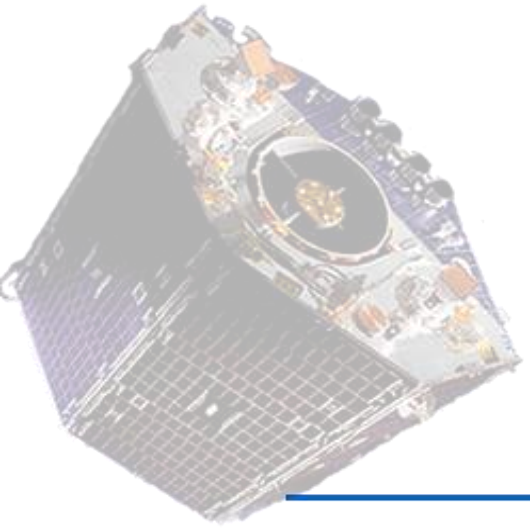
SPACE APPLICATIONS RESEARCH OUTCOMES

Space Based Assessment of Environmental Sensitivity To Desertification In Katsina State

- Desertification in Northern Nigeria is currently responsible for the loss of livelihood affecting 35 million people.
- NASRDA conducted a study in Katsina State to ascertain the sensitivity of the environment to desert conditions in the state.
- The findings show the variability of different areas of the state to desert conditions.
- These findings are essential for policy prescription.
- The policy interventions by the Government (e.g. Great Greenwall Development Agency) will vary from the northern parts of the state to the southern part.
- In the past, the same policy prescription is applied to the entire state.



Major Infrastructural Development



Major Infrastructural Development

Assembly Integration, Test and Design Center (AITDC) – Extent of Civil Works

- Civil works – 52% Completed
- Mechanical Design Laboratory – Work in Progress

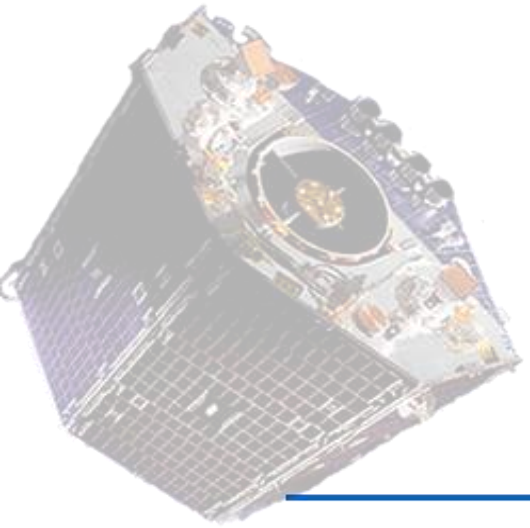
Major Infrastructural Development

Space Museum

Planetarium

To Promote Interest in Science and Mathematics in Nigeria

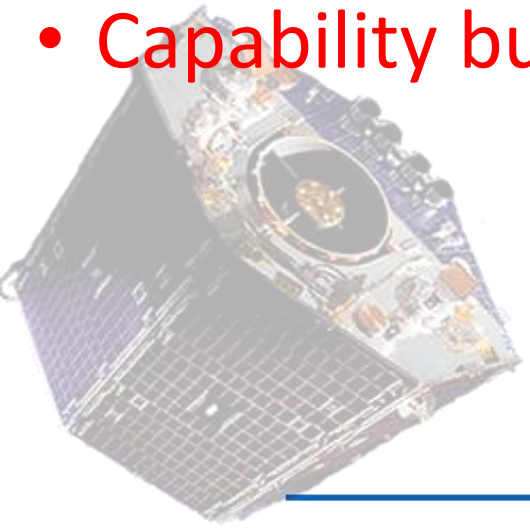
CONCLUSION



CONCLUSION

Nigeria investment in small satellites have helped the country to leapfrog its Space Programme most especially in the area of :

- Capacity building in Space Science and Technology
- Capability building in Space Science and Technology



THANK YOU…

National Space Research and Development Agency
Obasanjo Space Centre,
Airport Road, Abuja Nigeria
Website: www.nasrda.gov.ng

Nigeria Communication Satellite

- NigComSat-1 (2007) (De-orbited).
- NigComSat-1R launched in December 2011.
- Commissioned January 2012.

Expected Contribution to National Economy

- Retain over $300M Annually in Nigeria and Increase GDP.
- Reduce Tariffs on GSM Phone Services.
- Reduce Tariffs on Satellite Television Broadcasting Services.
- Link the Rural Areas with Telephone Services.
- Promote E-Commerce and E-Government.

Communication Satellite (NigComSat-1)

Before the Commercial handover the NigComsat-1 was deorbited. Replaced 2011

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

Communication Satellite

Telemedicine

Tele-Van

Tele-Boat

Technology in Government in Africa (TIGA) Award

- 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 .
- AU also recommended and endorsed this initiative for the rest of Africa