Paper Reference No: MAF08 PN 37

BUILDING REMOTE SENSING CAPABILITIES IN AFRICA: THE NIGERIAN EXAMPLE.

Abstract.
The second UN Conference on Exploitation and Peaceful uses of Outer Space (UNISPACE '82) held in Vienna, Austria; recommended that the UN programme on Space Applications (UN-SPA) should focus its attention, inter alia, on the development of indigenous capabilities in Space Science and Technology at the local level. The UN General Assembly endorsed the recommendation in its resolution 37/90 of 10 December, 1982. As a result, the Federal Government of Nigeria in1999 embarked on some laudable steps at pioneering the development of Space Technology in Africa which eventually led to the launching of Nigeriasat-1 and the preparation for the launch of Nigeriasat-2. Such steps also include the applaudable efforts and leadership in adopting Space Technology as a tool for Sustainable Environmental management in Africa and mapping out strategies for mobilizing the African continent to be active participants in the Space Technology industry to ameliorate problems such as prohibitive costs of image data source and lateness in arrival of such data for near real-time environmental monitoring and disaster management. This paper therefore reviews the efforts of the Federal Government of Nigeria at pioneering the building of Remote sensing capabilities in Africa.

Introduction

The paradigm that is fast gaining ascendary the world over today is the concept of sustainable development. It is defined as the development that meets the needs of the present without compromising the ability of future generation to meet their own needs. Development can be described as a form of economic process that could result in increase in social and economic well being (quality of life) of a people. Underdevelopment on the other hand is caused by poor quality of data collection and management practices; lack of adequate data infrastructure; and lack of skilled human capacity in natural resource and environmental management. These lead to food insecurity, deforestation, land degradation, erosion, forest fire, drought, desertification pollution etc and in short poverty. To fully tackle these challenges requires an understanding of a full range of earth science disciplines of which Remote Sensing is primordial.

The need for Remote Sensing Capacity

Remote Sensing is a key to the realization of the Millennium Development Goals and the objectives of any nation's holistic reforms agenda to reduce poverty and have sustainable development. Remote sensing guarantees the availability and speedy access to real time data, geo-spatial information and availability of relevant infrastructure backbone for information communication. Remote Sensing serves as a tool for environmental resources – biotic, abiotic and cultural assessment and monitoring. Remote Sensing has some fundamental advantages at gathering information that make it a veritable tool in environmental monitoring and management. These have been listed by Barret & Curtis (1976) to include:

- A capability for recording more permanently detected patterns
- Play-back facility at different speeds
- Opportunity for informative (objective) analysis of observations to minimize personal peculiarities of observers
- Means of enhancing images to reveal or highlight selected phenomena.
- The synoptic view advantage offered by raise platforms
- Ability to record data on otherwise inaccessible areas
- Ability to produce accurate data on large areas at desired time intervals and at relatively lower cost compared to the cost that would be incurred through ground survey methods
- Ability to record images in multispectral fashion at different stages, at different scale and spatial resolutions

Abiodun (2000) observed that "while to the developed world remote sensing is a cost saving method of acquiring raw data to update existing information, for developing countries especially those in Africa, it has provided an opportunity to obtain the first generations of information on some of their earth resources", and Fagbami (1993) noted that: remote sensing is the most important tool for rapid resource inventorying, development and management in developing countries". All of these thus imply that remote sensing technology has today become the defacto data and information gathering and analysis tool for sustainable development and poverty eradication. The greatest

problems that have perhaps militated against the wholesome acceptance and application of remote sensing technology by most developing countries especially in Africa include lack of understanding of the role of space science and technology in the development process; shortage of trained manpower; financially related problems of remote sensing data; inadequate hardware and software facilities for image processing (Abiodun 2000; Fagbami, 1993), and most importantly lack of contributory input to satellite launching and image acquisition processes.

Satellites in Africa

On 29 April, 1998, Egypt had Nilesat 101 that is been widely called the first satellite to be built and launched for an African country. On August 17, 2000, Egypt launched Nilesat 102 from the same place. Both Nilesat 101 and Nilesat 102 are however communication satellites. On February 23, 1999, South Africa launched an experimental satellite Sunsat in California as part of US – South African cooperation. It was designed to last for five years. Morocco also has a Satellite in Low Earth Orbit. Algeria has a 90kg Alsat-1 as one of the DMC launched in November 2002. Nigeria launched NigeriaSat-1 a 94kg as a member of the DMC on 27 September, 2003. Nigeria also launched a communication satellite Nigcomsat-1 on 14 May, 2007. Nigeria is also at an advanced stage to launching Nigeriasat-2. Egypt is also planning to launch Egyptsat-1 after an agreement in 2001 with a firm in Ukraine. None of these satellites however was launched by an African rocket or on an African soil. Developing a launch capability by the satellite – advanced countries and the developing ones has not been easy. Even the British did not have a rocket at the time of launch of Nigeriasat-1. Their UK-DMC had to be co-launched with five other satellites with a Russian rocket. In the 1980s, South Africa started work on the RSA-3 satellite launcher with the help of Israel but was later abandoned in 1984 because it was found not to be commercially viable. No African country has launch capability as of today.

Building Remote Sensing Capabilities

The Nigerian Example

The leadership role Nigeria is currently playing in the United Nations Committee on Peaceful Uses of Outer Space (COPUOS) actually started when the government of Nigeria in the 1975 – 1980 Development Plan, proposed the sum of 80,000 dollars for the establishment of a remote sensing centre. This was later inspired by the inter-governmental meeting of the Economic Commission for Africa of the OAU in Addis Ababa, Ethiopia in 1976. In April 1987, the Food and Agricultural Organization (FAO) at the request of Nigeria set up a committee whose report recommended the establishment of infrastructure for space science and technology in the country. In 1993, the National Agency for Science and Engineering Infrastructure (NASENI) set up a committee to formulate a National Space Science and Technology Policy for the country. The policy recommended among other things the creation of centres of excellence for the development of space science and technology; and the enhancement of the capabilities of institutions offering space related courses of study in the country. In 1999, the National Space Research and Development Agency (NASRDA) was established to pursue the development and application of space science and technology for the socio-economic benefits of the nation. In 2001, the government approved the National Space Policy and Programmes to serve as, roadmaps for transforming Nigeria from the status of a consumer nation to an active participant in space technology and allied fields. The objective of the National Space Policy and Programmes was to make space research and development activities part of the overall strategies for sustainable national development. The main thrust of the National Space Policy and programmes were:

- Development of human resources and capacity building in various areas of space science and technology
- To develop and build competence in space technologies of direct relevance to national development
- To develop strategies and space applications
- To undertake National Resource Management
- Defence, National Security and Law Enforcement
- Study of the Earth and its environment

- Communication and Information management
- Education and Training
- Provide support for universities and other academic institutions in space-related research and development projects
- Promote private sector participation in the space industry
- Promote international cooperation

To achieve all of these, six centers were created to act as the operational limbs NASRDA. These centers were:

1. Centre for Basic Space Science: The centre is mandated to provide a sound education, research and knowledge in basic space science, astronomy/astrophysics, rocketry and balloons, geomagnetism, etc as well as designing and fabricating appropriate systems and instrumentations and telescopes.
2. Centre for Remote Sensing: The centre is charged with the sole responsibility of harmonizing research and development in space science and technology application for sustainable socio-economic development in the country. To do this would require satellite data acquisition, archiving and distribution, possibly aided by the establishment of a multi-source satellite receiving station and development of application solutions, etc.
3. Centre for Satellite Technology Development: This centre has its primary focus on satellite technology development with indigenous critical mass of trained engineers and scientists in all rudiments of satellite technology – building, launching, telemetry, tracking and control of all kinds of satellites such as Earth Observation, Communication, Weather, Scientific Research, etc.
4. Centre for Geodesy and Geodynamics: This centre was established to facilitate capacity for geodetic surveying and mapping, as well as monitoring of coastal deformation and subsidence due to excessive oil and gas exploitation, floods and global mean sea level rise and other related seismic and geodynamic phenomena including implementation of international

agreements with respect to Satellite Laser Ranging (SLR), Very Long Baseline Interferometry (VLBI) and cooperative international GPS network

5. Centre for Space Transport and Propulsion: This centre focuses on rapid advances in the science and technology of Rocketry, which are main transportation vehicles.
6. Centre for Space Science and Technology Education: This centre affiliated to the United Nations African Regional Centre for Space Science. Its main function is to develop curriculum, skills and knowledge of University educators, research scientists and train other professionals and personnel in the applications of satellite remote sensing, meteorology, communication and geographic information system to sustainable development.

On the 27 September, 2003, Nigeriasat-1 was launched into orbit as Disaster Monitoring Constellation (DMC) with other satellites that belong to Turkey and UK. Algeria a member of the DMC had earlier launched her Alsat-1 of 90kg weight on the 28 November, 2002.The other members are China, Thailand and Vietnam. On the 14 May 2007, Nigcomsat-1 (a communication satellite was also launched). Presently, Nigeria is also working on Nigeriasat-2 with a designed life span of 7 years to be launched in 2009. Nigeriasat-2 will be an improvement on Nigeriasat-1 and is envisaged to be part of the proposed African Constellation Satellites in collaboration with Algeria, South Africa and any other interested African country as the bedrock of the African Resource Management (ARM) Satellite Constellation.

The main stream Geospatial Information has also been incorporated in the National Development Strategies through the establishment of National Geospatial Data Infrastructure (NGDI). This is to be coordinated by NASRDA with these concepts:

-Discovery, harmonization and standardization of geospatial data production and management, and the provision of a platform for data sharing thereby eliminating data duplication and conserving cost and time spent in producing already existing data.

-To promote greater awareness and public access to standard and coordinated geo-spatial production, management and dissemination by all sectoral institutions with linkages to private sector.

A 25 year road map – Space Mission was approved by the government of Nigeria in 2006, to produce a Nigerian Astronaut by 2015; launch a Nigerian-made satellite between 2018 and 2030; land a Nigerian Astronaut (to be part of the moon mission) by 2030; in capacity building produce Ninety five (95) Engineers and scientist in space technology and provide a world class space center in Abuja. The provision of a world class space center in Abuja has already been accomplished.

The benefits of Nigeriasat-1

Fifteen Nigerian engineers and scientists were trained in various aspects of space technology by Surrey Satellite Limited. During and after their training they took part in the design, construction, test, launch and orbital operation of Nigeriasat-1. The team is responsible for the control of Nigeriasat-1 in orbit from the Space Mission Control Centre Ground Station in Abuja. They have also acquired the know-how and expertise to design and build Low Earth Orbit micro-satellites similar to Nigeriasat-1. There is also a license from Surrey Satellite Technology Limited for this purpose, equipping the Ground Station and supply of a satellite module for the local training of Nigerians. Nigeriasat-1 data set have been found to be very reliable in flood study; fire scare mapping and monitoring; coastal erosion mapping; gully erosion mapping monitoring; identification and mapping of settlements; major roads and water bodies; disaster monitoring etc (NASRDA, 2007). Nigeriasat-1 can generate a maximum of 236,000 images over its design life of five years. The Landsat-5 with similar capabilities, but higher revisit time, is said to have the capabilities to raise an estimated 200 million US dollars yearly (Obba 2003) which means Nigeriasat-1 also has the capability of generating income within that range. The DMC satellites with their shorter revisit time are expected to stimulate the market for images and information for remote sensing all over the world and generate even more money which can be used to support future space programmes. Nigeriasat-1 has the advantages of frequent revisits and being locally available and free of foreign transaction problems. It will also provide a service that will greatly improve monitoring and the management and mitigation of disasters wherever and whenever they occur.

Africa – The way forward

African countries need to improve on their funding for science and technology through increase and steady budgetary allocation every year. The African Union (the then OAU) in its 1980 Lagos plan of Action has recommended a minimum allocation of 1% of GDP to Research and Development Science and Technology.

African countries as a matter of urgency need to embrace the science and technology programmes as contained in the New Partnership for African Development (NEPAD) agenda. African countries also need to develop a sound and workable national space policy like Nigeria that will be followed to achieve the required level in space technology development. This policy should also be implemented and not just be kept somewhere.

Developed countries should also be lobbied to assist African countries in whatever capacity to ensure that space technology grows and well-nurtured through training, collaboration etc.

African countries on their own can collaborate to develop space technology through joint launching as in the case of Nigeria and Algeria with others and transfer of space science and technology knowledge as the case of ARCSSTE-E in Nigeria and ARCSSTE-F in Morocco that are principally to boost the growth; domesticate capacities of African countries and to enable them to enhance their knowledge, understanding and skills in many aspects of space science and technology.

Conclusion

The benefits of space science technology especially remote sensing, both direct and indirect, have introduced new dimensions into the study and understanding of earth's processes towards improving the quality of life. An essential pre-requisite to partaking in these opportunities is the building of various indigenous capacities and capabilities for the development and utilization of space science and technology (ARCSSTE-E 2007). From the Nigerian example, one can see that with good policy and commitment it is possible to build not only Remote Sensing capabilities but space science technology as a whole for sustainable development and eradication of poverty. Let me end by quoting Sir Arthur Clark who says "Future opportunity will only be available to nations that invest in

technological innovations, human capital skills development, and investment in information and communication technology infrastructure" so Africa should wake up and grab the opportunity.

References.

Abiodun, A.A (2000) Development and Utilization of Remote Sensing Technology on Africa's Development, OAU/ECA experts Group meeting, Mbabane. Swaziland.

Barret, E.C and Curtis, L.F (1976) Introduction to Environmental Remote Sensing, Chapman and Hall.

Fagbami, A (1983) Remote Sensing in Land Resources Surveys and Development: Nigerian Journal of Remote Sensing, Vol 1, April, 1993.

Obba, K.O (2003) Nigeriasat-1: The full story, Apco and Associates ltd, Lagos.

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