Space-Based Disaster Management in Nigeria: The Role of the International Charter "Space and Major Disasters"

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SUMMARY

Globally, disasters have continued to cause severe catastrophic consequences in the loss of human lives as well as economic losses. For example, the magnitude 9.2 earthquake that occurred in the Indian Ocean on December 26, 2004, caused a large tsunami that flooded more than ten coastal countries and culminated in about 300,000 deaths with severe economic and environmental impacts. Similarly, between August 23, and August 30, 2005, Hurricane Katrina in the Gulf of Mexico led to 1,400 deaths with severe economic losses. Nevertheless, Nigeria is not located in high-prone natural disaster (e.g. earthquake, hurricane) zones, but the country has experienced cases of floods, coastal erosion, sand storms, landslides, oil-spillage, and desertification disasters. These disasters have resulted in the loss of lives as well as properties. For example, about 100 people died in Ibadan due to flood in 2011 while 5,000 people were displaced with severe economic impacts. As a result, disaster management in Nigeria has become a primary focus of Government at the Federal, State and Local levels. Given the role of space technology in disaster management, the Nigerian Government, through the National Space Research and Development Agency launched NigeriaSat-1 earth observation medium resolution satellite in 2003. The satellite was launched into the Disaster Monitoring Constellation (DMC) and as a result, Nigeria through the DMC is a member of the international charter "space and major disasters". The Charter was initiated by the European Space Agency (ESA), the French Space Agency and the Canadian Space Agency in 2000. Today, the membership of the charter has expanded to become an international collaboration among space agencies known as the Charter members. The founding agreement of the Charter is to provide a mechanism for rapid tasking of satellites for immediate, short-term disaster preparedness and response. Consequently, the Charter provides free of charge optical and non-optical satellite-based information services to national disaster management authorities – the Charter authorized users - and humanitarian organizations for supporting immediate response to major natural or man-made disasters. Once the charter is activated, any satellite within the Charter that flies over the disaster area for which the Charter was activated is expected to image such area. Consequently, this manuscript documents the charter activations in Nigeria in 2010, 2011, and 2012, in response to the flood disasters in Sokoto, Ibadan, and Adamawa, kogi and Bayelsa.

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1. INTRODUCTION

A disaster is a swift, catastrophic event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources (IFRC 2012). The combination of hazards, vulnerability and the inability to reduce the potential negative consequences of risk results in disaster. As a result, disasters influence the mental, socio-economic, political as well as the cultural state of the affected area. Hence, disasters are considered as the consequence of inappropriately managed risk (Quarantelli 1998). These risks are the product of a combination of both hazard/s and vulnerability. Therefore, hazards that strike in areas with low vulnerability are less likely to become disasters, as is the case in uninhabited regions. Disasters are generally grouped into two types, namely natural and anthropogenic or human-made. Natural disasters are caused by natural processes in proximity to, and pose a threat to, people, structures or economic assets. Examples of such disasters are flood, cyclone, drought, earthquake, tsunami, cold wave, thunderstorms, volcanic eruption, heat waves, mud slides, and storm. Conversely, anthropogenic or human-made disasters are associated with human action or inaction. Examples of such disasters include: technological failures, industrial accidents, oil spills, transportation accidents and nuclear explosions/radiation. Nevertheless, the focus of this manuscript is natural disasters. Natural disasters have been around for a while, dating back to the early human civilization. During this period, natural disasters were perceived as acts of God (Drabek 1991) or retribution from the gods (Quarantelli 1998). Nonetheless, the evolution of science questioned the integrity of these beliefs. According to Niekerk (2007), some of the earliest contributions to the field of disaster science were from Carr (1932), Sorokin (1942), Eldenman (1952), Quarantelli (1954 and 1957), Moore (1956), Fritz and Williams (1957), Drabek and Quarantelli (1967), Doughty (1971), Hewitt and Burton (1971), Kreps (1973), Westgate and O'Keefe (1976), Jager (1977), Torry (1978), and Turner (1978). Notwithstanding these seminar contributions to the understanding of the concept of disasters, natural disasters have become a major threat to human life and the world economy.

2. INTERNATIONAL DISASTER MANAGEMENT INITIATIVES

Although natural disasters cannot be avoided, studies have shown that adequate disaster management plan can reduce its impacts on lives and properties. Moreover, disasters often do not respect national or international boundaries. As a result, governments and international organizations are cooperating to promote global and regional initiatives to address the full/partial disaster management cycle consisting of mitigation, preparedness, response and recovery (Figure 1).

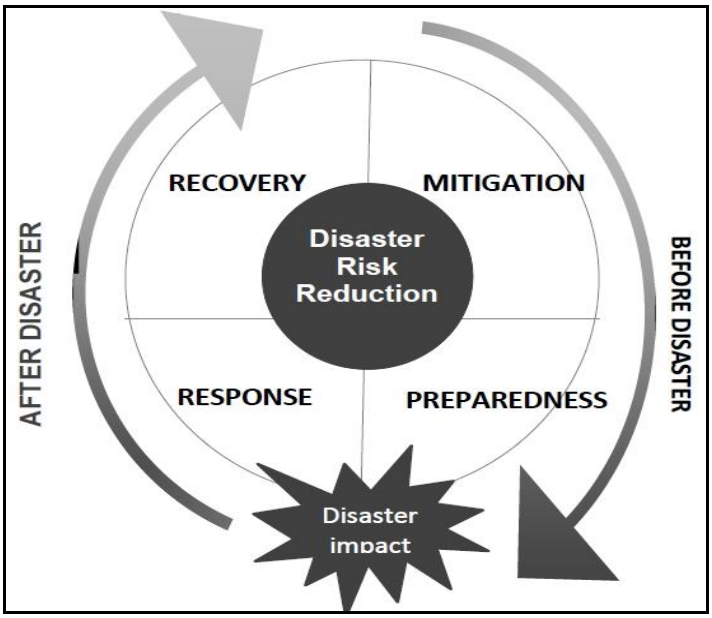

Figure 1: Full Disaster Management Cycle
Adapted from Twigg,*J. (2004)*

Some of these initiatives are: The International Charter "Space and Major Disasters" (ICSMD), Disaster Monitoring Constellation (DMC), The United Nations Platform for Space Based Information for Disaster Management and Emergency Response (UN-SPIDER), and The United Nations International Strategy for Disaster Reduction (UNISDR).

2.1 International Charter "Space and Major Disaster"

The International Charter "Space and Major Disasters" (ICSMD) is an international collaboration among space agencies/organizations called the Charter members. The concept was initiated by the European Space Agency (ESA), the Centre National d'Etudes Spatiales (CNES) of France and the Canadian Space Agency in 2000. However, eleven other space agencies/organizations joined the Charter between 2001 and 2012. These Agencies/organizations include: Indian Space Research Organisation (ISRO), National Oceanic and Atmospheric Administration (NOAA), United States Geological Survey, Disaster Monitoring Constellation International Imaging (DMCii), China National Space Administration, German Space Agency (DLR), Korean Aerospace Research Institute (KARI), National Institute for Space Research (INPE) of Brazil, European Organisation for the Exploration of Meteorological Satellite (EUMETSAT), Japan Aerospace Exploration Agency (JAXA), and Argentinean National Commission on Space Activities (CONAE). The objectives of the charter as provided for in the Charter document are to "*supply during periods of crisis, to States or communities whose population, activities or property are exposed to an imminent risk, or are already victims, of natural or technological disasters, data providing a basis for critical information for the anticipation and management of potential crises; participation, by means of this data and of the information and services*

resulting from the exploitation of space facilities, in the organisation of emergency assistance or reconstruction and subsequent operations" (ICSMD 2013). Given these objectives, the ICSMD provides space-borne data on disasters that may have the potential of causing significant loss of life and/or property. This space-based dataset is viewed as an important complement to terrestrial based ancillary information. As a result, the Charter is intended to serve the response phase of disasters. Similarly, long-term monitoring of severe environmental phenomena, such as droughts, and activation in response to acts of war or other non-environment-related humanitarian emergencies (such as refugee crises) are excluded from the Charter's activities (ICSMD 2013). However, individual Charter member organisations may augment their satellite data provision on their own accord and outside their Charter commitments. A major commitment by recipients of satellite imagery from the Charter is the observation by such recipients of all the member agencies' policies for intellectual property/copyrights and governing data distribution and use. This implies that the satellite images received for a particular disaster cannot be used for other purposes other than the charter activation. Such satellite data consist of newly acquired imagery when the Charter is activated as well as reference imagery of the disaster area predating the disaster event.

The Charter provides access to a constellation of satellites equipped with radar and optical sensors. The Radar Sensor include: ERS-2, ENVISAT, RADARSAT-1, RADARSAT-2, ALOS PALSAR, TerraSAR-X. Conversely, the optical sensors consist of SPOT4, SPOT5, IRS-1C, IRS-P6, IRS-P5, LANDSAT5, LANDSAT7, PROBA 1, ALOS AVNIR/PRISM, ALSAT, NIGERIASAT-2, UK-DMC1 and UK-DMC2, CBERS-2, KOMPSAT-2, MERIS, POES, GOES, SAC-C, MODIS and TERRA/AQUA (ICSMD 2013). The Charter activation and operational process consists of five set of steps. First, an Authorized User can call a single number to request the mobilization of the space and associated ground resources of the member agencies to obtain data and information on a disaster occurrence. Second, a 24-hour on-duty operator receives the call, checks the identity of the requestor and verifies that the User Request form sent by the Authorized User is correctly filled up. Third, the operator passes the information to an Emergency On-Call Officer who analyzes the request and the scope of the disaster with the Authorized User, and prepares an archive and acquisition plan using available space resources. Fourth, data acquisition and delivery takes place on an emergency basis, and a Project Manager, who is qualified in data ordering, handling and application, assists the user throughout the process. Fifth, the final product is delivered to the end users. Since the inception of the Charter, this process has been repeated for 296 disasters in 100 countries as at 10th of January 2013 (ICSMD 2013).

2.2 Disaster Monitoring Constellation

The Disaster Monitoring Constellation (DMC) is an earth observation satellite resource that enables high frequency imaging anywhere on earth from a group of multiple satellites in a constellation. This advantage of high temporal resolution made the facility essential for disaster management. The DMC was first proposed in 2000. However, the first satellite in the DMC called AlSat-1, owned by Algeria's Centre National des Techniques Spatiales (CNTS), was launched in 2002. Other satellites that later joined the constellation included UK-DMC-1 owned by UK, NigeriaSat-1 owned by Nigeria, and BILSAT-1 owned by Turkey. These

satellites were launched in 2003. These four satellites constituted the first generation of the DMC constellation. The spatial resolution of the satellites in the constellation ranged from 4 metres in panchromatic mode to 32 metres in multispectral mode. However, these satellites have been retired and are no longer in operation. Nevertheless, a second set of satellites have been launched to form the second generation of the DMC, called DMC-2. The satellites within DMC-2 include Beijing-1 (China), launched in October 2005; UK-DMC 2 (United Kingdom), launched in July 2009; Deimos-1 (Spanish commercial), launched in July 2009; and NigeriaSat-2 and NigeriaSat-X launched in August 2011. The uniqueness of this constellation is that the sun-synchronous orbits of these satellites are coordinated so that the satellites follow each other around an orbital plane, ascending north over the equator at 10:15 am local time (and 10:30 am local time for Beijing-1). The DMC through the DMC international imaging limited is a member of the ICSMD. Hence, the disaster management agencies of all the member countries of the DMC can activate the ICSMD for disaster management. Consequently, Nigeria, being a member of the DMC can activate the ICSMD through the DMC international imaging. In addition, Nigeria can activate the Charter directly.

2.3 United Nations Platform for Space Based Information for Disaster Management and Emergency Response (UN-SPIDER) Programme

The United Nations Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER) programme was established through the United Nations General Assembly resolution 61/110 of 14th December 2006 (A/RES/61/110). The resolution mandated the programme to provide universal access to all types of space derived information and services relevant to the full disaster management cycle. This is achieved by serving as a bridge to connect the disaster managers and space communities, and by being a facilitator of capacity-building and institutional strengthening, particularly for developing countries.

In paragraph 10 of the United Nation's Committee on the Peaceful Uses of Outer Space (COPUOS) document A/RES/61/110, Nigeria was listed among the 13 countries that made commitments of support for the establishment of the UN-SPIDER programme. Through such commitment, the National Space Research and Development Agency is host to the UN-SPIDER regional support office in Nigeria. The regional support office coordinates the activities of the programme in West and Central African countries. The office became operational on the 4th of June 2009, during the 52nd Session of the Committee On the Peaceful Uses of Outer Space (COPUOS). The operational responsibilities of the regional support office includes: Assist in linking the activities of the national focal points within the region to existing local and regional networks/capacities; Facilitate regional capacity development in Geographic Information System/Remote Sensing capabilities at the emergency management authorities (national or regional); Sort out regional/national information requirements including issues such as sensitivity and data sharing policy at national level; and customize UN-SPIDER informational assets to regional needs. Given these responsibilities, the regional support office have provided technical support to the project managers appointed during the activations of the International Charter "Space and Major Disasters" in Nigeria.

2.4 United Nations International Strategy for Disaster Reduction

The United Nations International Strategy for Disaster Reduction (UNISDR) was established in December 1999 with United Nations General Assembly (GA) resolution 54/219 as a successor arrangement of the secretariat of the International Decade for Natural Disaster Reduction (IDNDR) with the purpose of ensuring the implementation of the International Strategy for Disaster Reduction (ISDR) adopted by the General Assembly with the same resolution. Similarly, in 2001, the United Nations General Assembly with resolution 56/195, specified that the mandate of UNISDR is to serve as the focal point in the United Nations system for the coordination of disaster reduction and to ensure synergies among the disaster reduction activities of the United Nations system and regional organizations and activities in socio-economic and humanitarian fields. This was in response to the need identified during the IDNDR to mainstream disaster risk reduction within the development and other areas of work of the United Nations. This became necessary given that decades of success in national and international development maybe wiped out in a single disaster. As a result, in January 2005, 168 governments met in Kobe, Japan to discuss how they could reduce the impact of disaster and adopted a plan of action called the Hyogo Framework for Action 2005-2015.

3. DISASTER MANAGEMENT IN NIGERIA

The institutionalization of disaster management in Nigeria began in 1906 with the establishment of the Fire Brigade combated fire and provided humanitarian aid and relief to minimize disaster impacts (NDMF 2012). Nevertheless, formal large-scale state organized disaster management began in 1976 with the establishment of the National Emergency Relief Agency (NERA) which focused on the aftermath of disasters and tended to the needs of disaster victims (NDMF 2012). Following the strategies outlined by the UN International Decade for Natural Disaster Reduction (IDNDR), the Federal Government of Nigeria (FGN) in 1993 expanded the authority of the National Emergency Relief Agency (NERA) to include all stages of disasters and established the agency as an independent body under the Presidency. The National Emergency Relief Agency (NERA) was restructured again in March 1999 when the agency assumed its current title, National Emergency Management Agency (NEMA), that enabled the agency to oversee a more holistic approach to the management of disasters in all phases and all associated consequences. As a result, NEMA has a preliminary contingency plan in place, called the National Disaster Response Plan (NDRP); this establishes a process and structure for the systematic, coordinated, and effective delivery of Federal assistance to address the consequences of any major disaster or emergency declared by the President of the Federal Republic of Nigeria. As a supplemental policy document to the National Disaster Response Plan (NDRP), the National Disaster Management Framework (NDMF) Thematic Areas has been drafted for implementation.

4. ACTIVATION OF THE INTERNATIONAL CHARTER "SPACE AND MAJOR DISASTERS" IN NIGERIA (ICSMD)

The activation of the ICSMD in Nigeria is a relatively new concept to disaster management in the country. This is made possible due to the launch of Nigeria's first earth observation satellite (NigeriaSat-1) in 2003 into the Disaster Monitoring Constellation which is a member of the ICSMD. The Charter, being a new concept in Nigeria, required capacity building for NEMA (Authorized User) and other stakeholders in the country. As a result, the Authorized Users training was conducted in 2008 and was followed with the project managers training in 2010. Similarly, a mock charter activation exercise was conducted in 2010 to test the new skills developed by the project managers. Prior to ICSMD activations in Nigeria, it was a major challenge to identify communities devastated by disasters (particularly natural disasters in the rural areas) using terrestrial approaches. This is particularly true since access to such remote areas is often made impossible by the disaster. However, access to earth observation satellite imagery provides a solution by enabling synoptic view of areas affected by disasters as well as the optimum access to such areas. Consequently, between 2010 and 2012, the ICSMD was activated by the authorized user (NEMA) on behalf of Nigeria in 2010, 2011 and 2012 for floods in Sokoto (Charter Call 324 and 326), Ibadan (Charter Call 370), and Adamawa (Charter Call 407), Kogi (Charter Call 415), Bayelsa (Charter Call 416), respectively. The results from these activations have enhanced the ability of NEMA to respond to disasters swiftly and efficiently. Moreover, these activations complemented the Nigerian satellite infrastructures, Nigeriasat-1, NigeriaSat-2 and NigeriaSat-X.

4.1 Sokoto Flooding (Charter Call 324 and 326)

The flood disaster occurred on the 9th of September, 2010 affecting Sokoto and Kebbi States in North-West Nigeria. The flood disaster was driven by heavy down pour of rain in the days leading up to the 9th of September. This resulted in the failure of the Goronyo Dam and the subsequent overflowing of River Rima. The ICSMD was activated on the 13th of September, 2010 as Charter Call 324 to help identify affected settlements in Sokoto State. The Project Manager for this activation was nominated from the Regional Centre for Aerospace Surveys (RECTAS). However, on the 16th of September, 2010, there was an extension of the area of interest to cover the downstream areas of River Rima in Kebbi State which had been impacted by the floods and thus Charter Call 326 was made. Following the Charter activation, images of affected areas were made available from the following satellites: ALOS, RADARSAT-2 and Envisat. The images were processed for information extraction and the final map products delivered to NEMA for the response phase of the disaster. These map products are presented in Figures 2 and 3. The results indicated that 17,425 Sq. Km area was inundated while some of the settlements along the floodplain of the River Rima affected include: Gada, Shinaka, Goronyo,Katami, Wurno, Augi, Kalgo, Gummi, Geza, Arugungu.

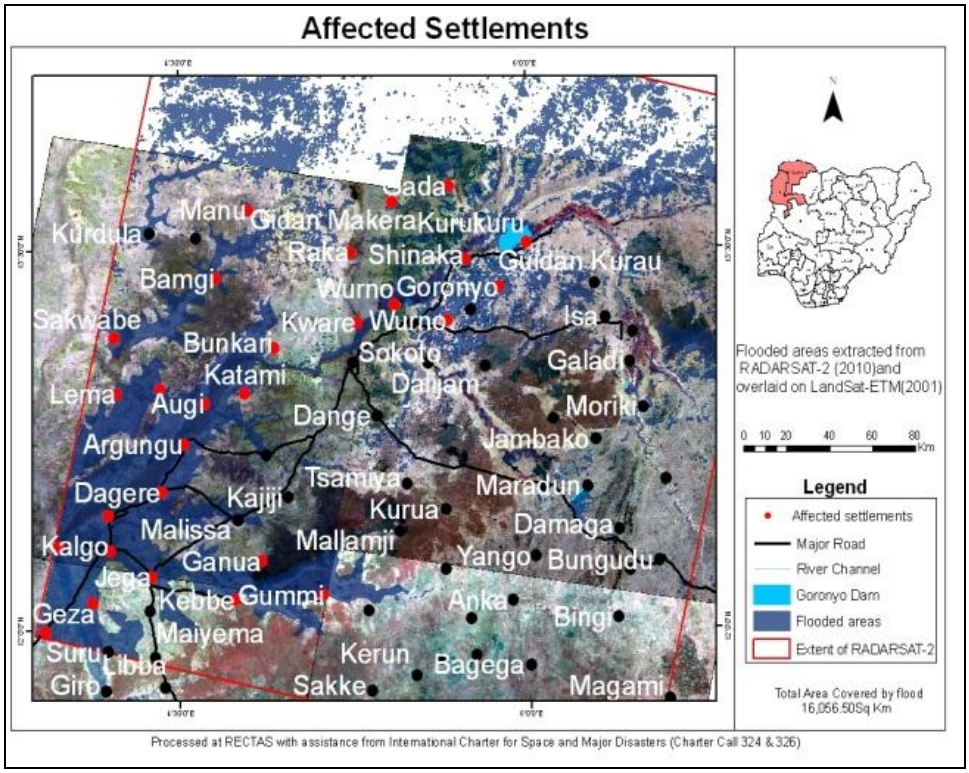

Figure 2: Affected Settlements from Charter Call 324 and 326

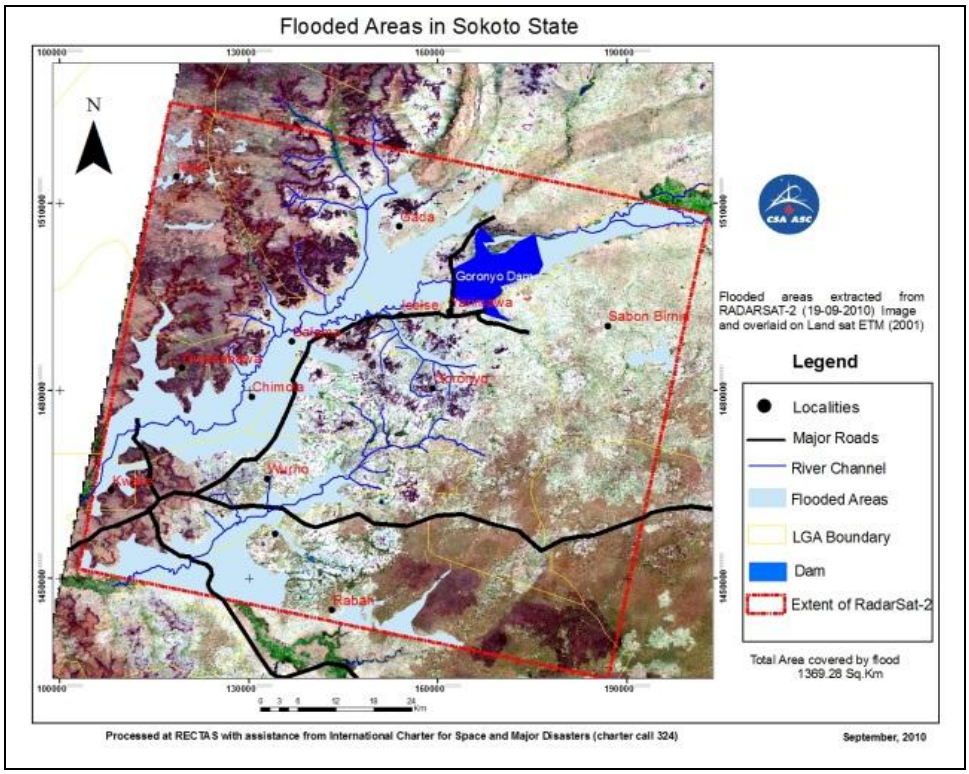

Figure 3: Affected Settlements from Charter Call 324

4.2 Ibadan Activation: Charter Call 370

On Friday, 26th of August 2011, torrential rain resulted in severe flooding in Ibadan, the Oyo State capital in south western Nigeria. Following the flood disaster, NEMA activated the ICSMD on the 29th of August 2011 (Charter Call 370). A project manager was nominated from NASRDA. The data provided by the Charter included: TerraSAR radar imagery acquired on 31st of August 2011, RadarSat-1 and RadarSat-2 imagery acquired on 28th of December 2003 and 31st of August 2011, respectively. The other dataset included Spot Image acquired on the 1st of August 2011 and 31st of August 2011. Additional dataset were provided from Envisat; they were acquired on the 4th of January 2005, 2nd of September 2009, 9th of June 2009, 21st of May 2010 and 22nd of September 2010. A unique pattern of the data indicated that both pre-flooding and post-flooding images were provided by the Charter. Additionally, Landsat Enhanced Thematic Mapper Plus (ETM+) images were acquired from the Global Land Cover Facility (GLCF 2011) as well as images from NigeriaSat-1. The images were processed by the project manager with technical support provided by the UN-SPIDER regional support office in Nigeria. The map product generated is presented in Figure 4. The local government areas affected by the flood were Oluyole, Ibadan North, Ibadan South East, Ibadan South West, Egbeda, and Ido. The following communities were severely impacted: Bodija, Odo-ona Oke Ayo, Odo-ona Elewe, Apete, Oluyole Industrial Estate, Onipepeye, Eleyele Dam Area, Ologun Eru, Ogbere Idi Obi, The Polytechnic-Ibadan, University of Ibadan and Agbowo.

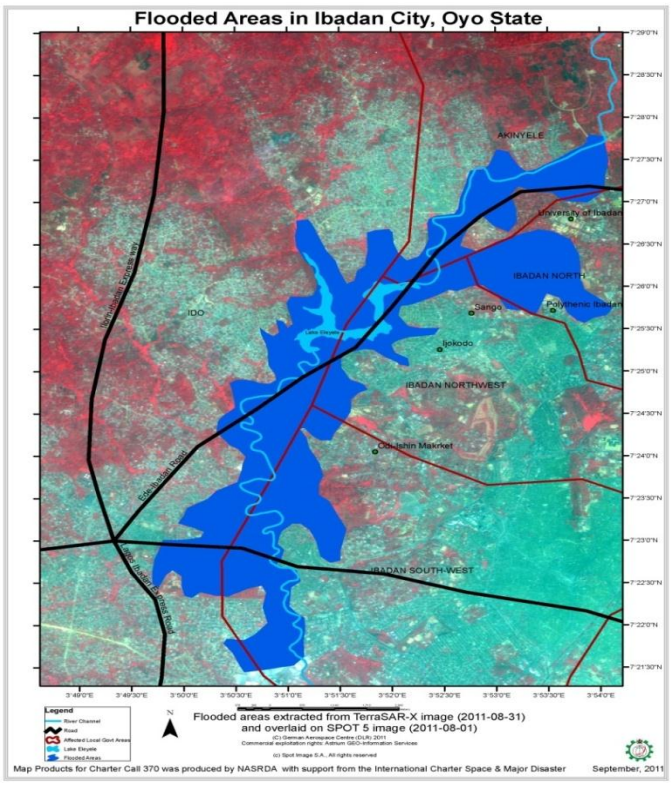

Figure 4: Ibadan Flooded Areas derived from Charter call 370

Adamawa Activation: (Charter Call 407)

On the 22nd of August 2012, torrential rains resulted in the rise of water level in Lagdo dam, Cameroun. As a result, the Cameroonian authorities informed the Nigerian Government on the 23rd of August 2012 of the need to open the dam and release excess water. Consequently, the dam was opened on the 24th of August 2012 following the alert given to the Nigerian government, a day earlier. This resulted in the flooding of major towns in the downstream along the River Benue tributaries, Adamawa and Taraba states, in particular. Consequently, NASRDA commenced the process of gathering available satellite imagery of the affected areas. For example, pre-disaster 5m satellite imagery was obtained to serve as the base map for change analysis that will be performed to ascertain the flooded areas. In addition, NASRDA tasked its NigeriaSat-2 and NigeriaSat-X satellites. Subsequently, the ICSMD was activated by NEMA on the 29th of August 2012. A Project Manager (PM) was nominated from NASRDA on the 30th of August 2012. Pre-disaster (archived imagery) and post-disaster imagery were sought from the following agencies and organization: German Space Agency (DLR), Astrium Geo-information Services, Canadian Space Agency, Centre national d'études spatiales, United States Geological Survey (USGS), and Indian Space Agency (IRS). Satellite imagery were thereafter obtained from German Space Agency (DLR) and Canadian Space Agency. The images from the optical satellites were cloudy and thus were not useful. Results from the image interpretation revealed that ten local government councils were affected in Adamawa state including: Fufore, Girei, Yola-South, Yola-North, Demsa, Numan, Lamorde,

Shelleng, Michika, Guyuk and Ganye. The other states affected by the floods include Taraba and Benue states. The final product forwarded to NEMA for disaster response is presented in Figure 5.

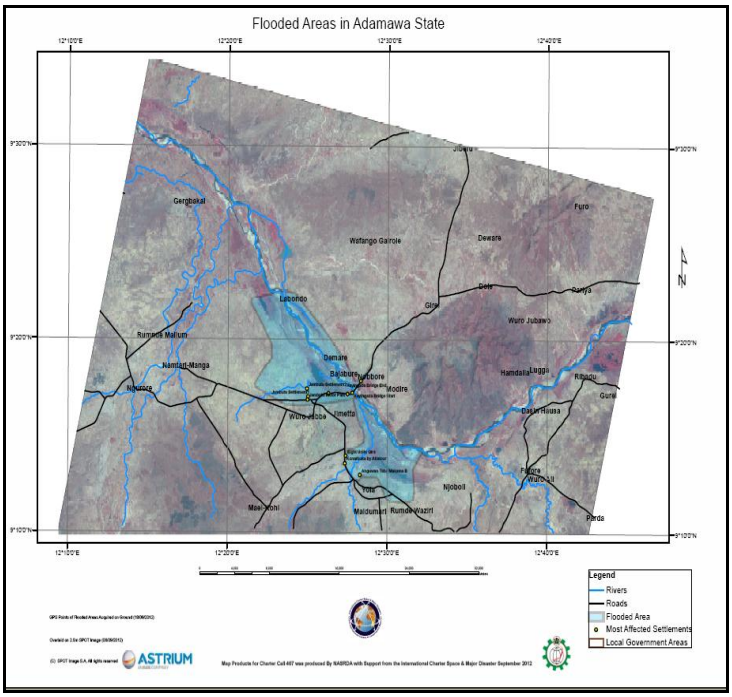

Figure 5: Results from Charter Call 407

4.3 Kogi State Flood Event: Charter Call 415

The Kogi state flood event took place on the 25th of September, 2012. This was as a result of rising water levels in both Rivers Niger and Benue. Therefore, the ICSMD was activated by NEMA on the 25th of September, 2012. The UNSPIDER regional support office in Nigeria hosted by NASRDA coordinated the activities locally, while RECTAS provided the Project Manager (PM) for the activation. The PM was granted access to archival and programmed satellite imagery from the following satellites: TerraSAR-X/TanDEM, RADARSAT-2, SPOT5, Komposat-2, Envisat and NigeriaSat-2. However, due to cloud cover, SPOT5 and Komposat-2 imagery were not useful. The archival data from NigeriaSat-2 provided the pre-disaster image of the affected area. Similarly, TanDEM data was useful in identifying the floodplains, and through the process of threshold segmentation, areas with similar signature were extracted from the TerraSAR-X images. However, TerraSAR-X was used to monitor and assess the first stage of the flooding i.e. northern parts of Kogi state including Lokoja metropolis, while RADARSAT-2 was used to map the extent of the flood in southern parts of Kogi state. This decision was taken due to the smaller footprint of the TerraSAR-X images (30km) compared to RADARSAT-2 (100Km). The map products delivered to NEMA are presented in Figure 6 and Figure 7.

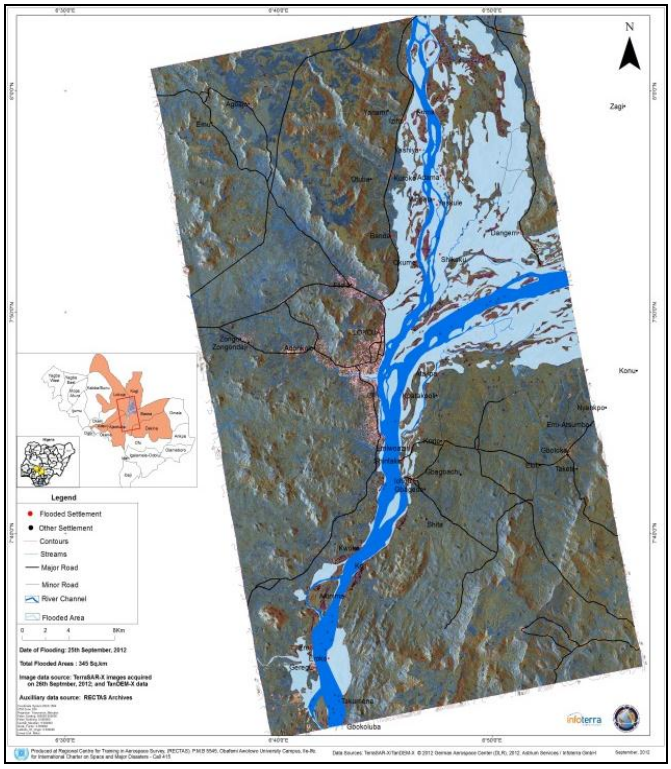

Figure 6: Extent of Floods in Lokoja and environs

Figure 7: Extent of Flood in Kogi State

The results of the analysis revealed that the extent of the flooded area was 820 Sq. Km. This affected major road networks in Kogi State, including Abuja-Lokoja expressway and Ajaokuta-Lokoja highway. In addition, some of the settlements affected include: Lokoja, Mimi, Banda, Shikaku, Ajaokuta, Idah, and Ibaji.

4.4 Bayelsa State Flooding: Charter Call 416

This activation was initiated on the 10th of October 2012 while the project manager was nominated from RECTAS. The initial activation was to cover communities affected by flooding in Yenagoa and adjoining communities. However, by the 11th of October 2012, the United Nations Institute for Training and Research (UNITAR) requested for an extension of the area of interest (AOI) to cover communities affected in Rivers State. The following satellites were tasked for image acquisition: SPOT5, RADARSAT-2, TerraSAR-X/TanDEM, Landsat ETM, IKONOS, Worldview, and FORMOSAT-2. However, only programmed datasets from RADARSAT-2 and TerraSAR-X was used in the post-flooding analysis through the process of segmentation of similar spectral values. SPOT-5 and NigeriaSat-2 archival images were used for pre-disaster analysis and assessment of affected infrastructures. The programmed image acquisitions from Landsat, IKONOS and other optical satellites were not viable due to extreme cloud cover.

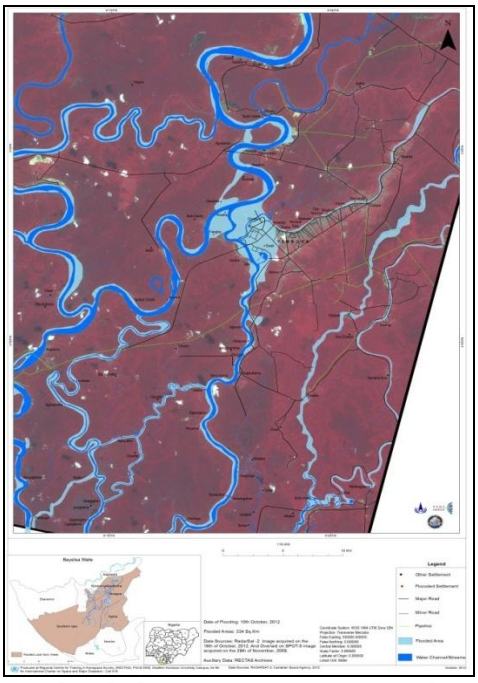

Figure 8: Flooded Areas in Yenagoa and Environs

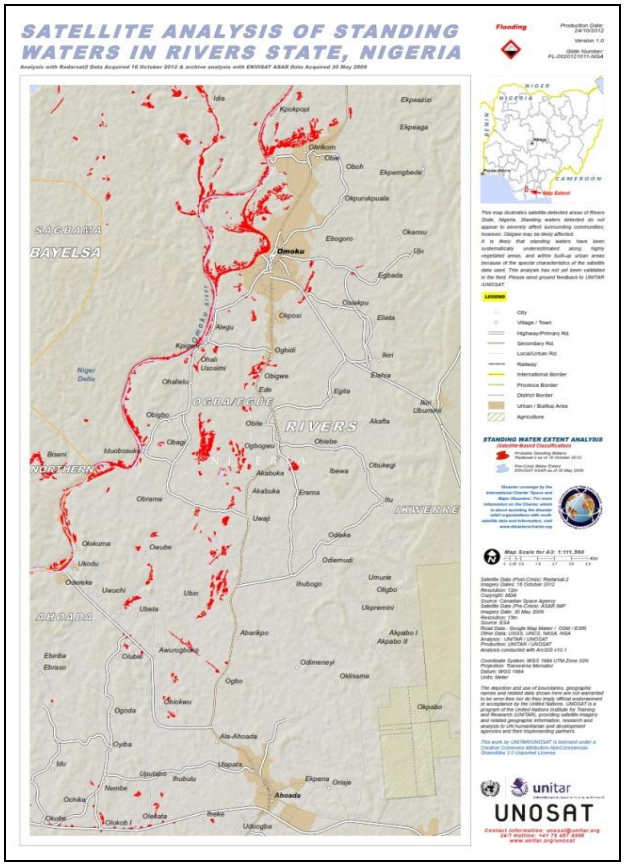

Figure 9: Flooded Areas in Parts of Rivers State.

The map products generated from the image analysis are presented in Figures 8 and 9. The total area impacted by the floods was 334 sq. km in Bayelsa State, affecting virtually all communities south of Yenagoa (Figure 8). On the other hand, the incidence of floods in Rivers state was not as severe, affecting only Idia, Omoku, Obikwe and Biseni communities, among others. The interpretation of the Radar images in these areas was hampered by the density and canopy cover of the mangrove forest.

5. CONCLUSION

Disasters will always be a recurrent event. However, their impacts are contingent on preparedness as well as efficient response. The capacity for effective response to and assessment of the impact of disasters within Nigeria has greatly improved following the access to the ICSMD. The Charter is an attestation to the notion that disaster management is a global phenomenon. No individual country has all it takes to respond to disasters. For example, during the Huricane Katrina in the United States in 2005, the ICSMD was activated. It is noteworthy that NigeriaSat-1 satellite was the first available satellite to image New Orleans and other areas affected by the flood. Back home, in Nigeria, the Charter has been activated five times during flood events in Sokoto (2010), Ibadan (2011), Adamawa (2012), Kogi (2012) and Bayelsa (2012). The efficacy of space-based approach to disaster management is informed by the fact that access to areas affected by disasters is often a major

challenge and thus satellite images provide efficient means of identifying areas affected by the disaster in a safe and efficient way. The continuous collaboration between NEMA, NASRDA and RECTAS for disaster management in Nigeria is a classical example of inter-agency cooperation to achieve a common goal of minimizing the loss of lives and property during disasters in Nigeria.

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