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THE REVISION OF 1:50000 TOPOGRAPHIC MAP OF ONITSHA METROPOLIS, ANAMBRA STATE, NIGERIA USING NIGERIASAT-1 IMAGERY

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ABSTRACT
Topographic maps are needed almost in every aspect of public and many private sector activities, including general engineering and construction works, economic and physical planning regulation, environmental management, general planning and as a base map for land use/land cover mapping. Most of the topographic maps available in Nigeria are outdated including that of Onitsha and its environs. Consequently, they cannot be used for the desired needs. This study focused on the use of NigeriaSat-1 imagery of 2006 in revising and analyzing 1:50000 topographic map (1964) of Onitsha metropolis. The NigeriaSat-1 and the digitized and georeferenced topographic map of the study area were co-registered to the 28.5m resolution of Landsat-7 ETM+ using ILWIS 3.3 software. The satellite imageries were classified and the classified images were vectorized in ArcGIS 9.3 Software and integrated with contour generated from SRTM data of 2000 to produce revised topographic map of Onitsha Metropolis (2006). The SRTM data of 2000 was used despite the difference in years (6years), because a sample survey revealed that the topography has not changed significantly between 2000 and 2012 within the study area. The study recommends among others that Medium-scaled topographic map coverage of the entire country should be carried out without further delay.

KEYWORDS: GIS, Remote Sensing, Topography, Satellite Imagery

INTRODUCTION

Up-to-date and accurate maps are basic tool for any meaningful planning, Systematic development and effective management of the natural resources of any nation. But the Nigerian 1:50000 topographic maps are outdated and thus not very suitable for effective planning, environmental management and sustainable development in Nigeria (Ufuah, 2003). This can be achieved through the process of map revision. By comparing topographic maps of the same area made at different time periods at the same scale, we can observe without difficulties the changes that have taken place as well as plan for further changes in positive manner. Data about these changes in the landscape can be collected through Field Survey, Aerial photograph, Satellite imageries, existing line maps and other sources (Okpala-Okaka, 2008).Topographic map revision using satellite imageries or Remote sensing data provides reliable, timely, accurate and periodic data (Igbokwe, 1996). In this study, NigeriaSat-1 imagery of date (2006) was used to revise (1964) 1:50000 topographic map of Onitsha metropolis in Anambra State, Nigeria.

The Study Area

The study area (Onitsha Metropolis) is located between Latitudes $06^{0}02^{1}56^{11}$N and $06^{0}38^{1}34^{11}$N and Longitude $06^{0}37^{1}30^{11}$E and $06^{0}59^{1}30^{11}$E and covers Onitsha North and South Local Government Area and part of Obosi, Nkpor and Iyiowa Odekpe of Anambra State. It is bounded by Anambra West/East L.G.A. and Oyi in the North, Idemili-North/South in the East, Ogbaru L.G.A in the South and in the West by the River Niger. Onitsha is the largest urban center in Anambra state and is also a major commercial town east of the Niger.

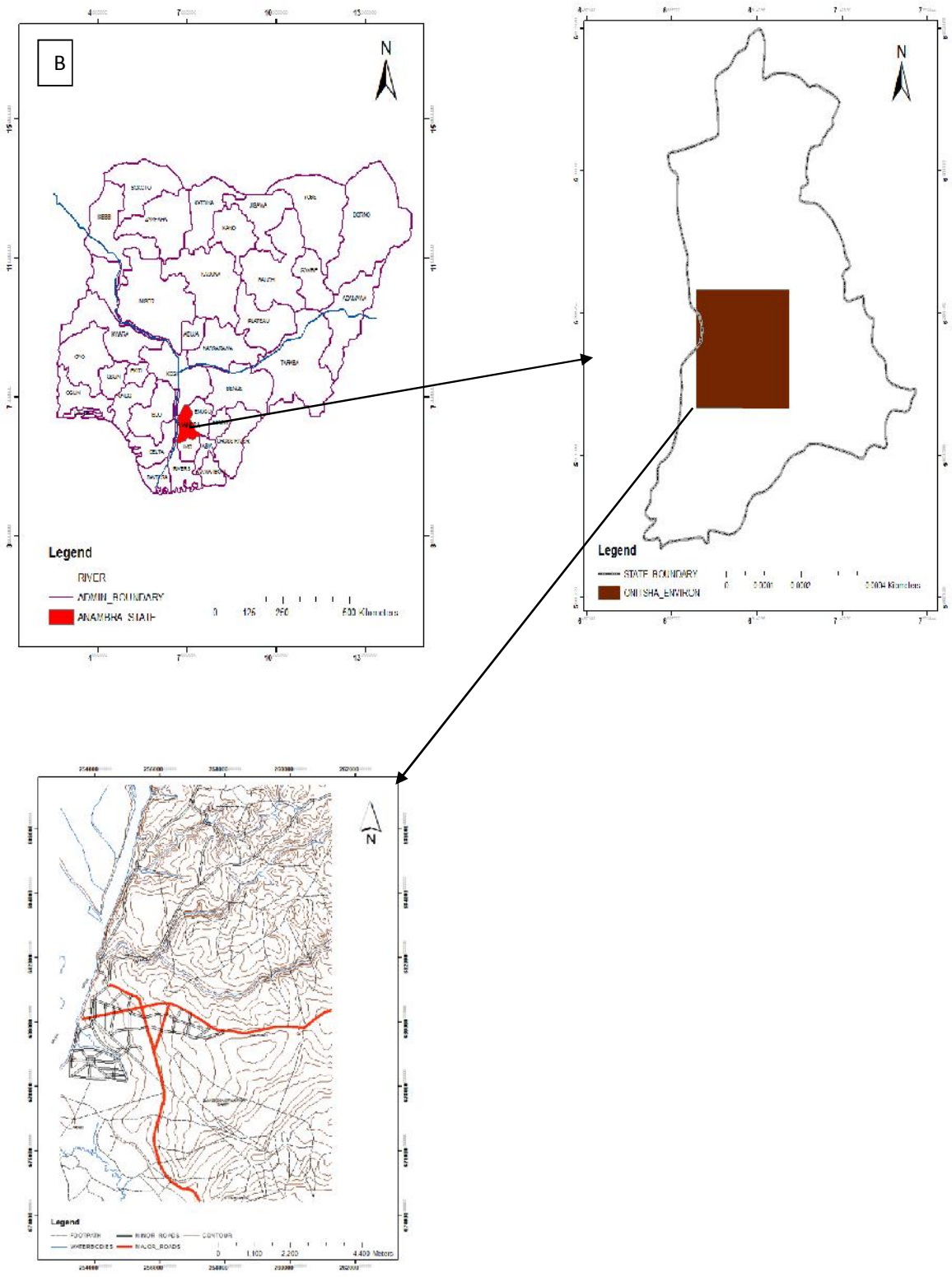

Fig. 1(A): Map of Nigeria Showing Anambra State; (B) Map of Anambra State Showing Onitsha metropolis, the Study Area; (C) 1964 Digitized Topographic Map of Onitsha Metropolis, the Study Area.
Source: Adapted from Analogue Maps obtained from Ministry of Land, Survey and Town Planning, Awka, Nigeria.

MATERIAL AND METHODS

The methodology adopted in order to achieve the aims and objectives of the study is represented in figure 2.0

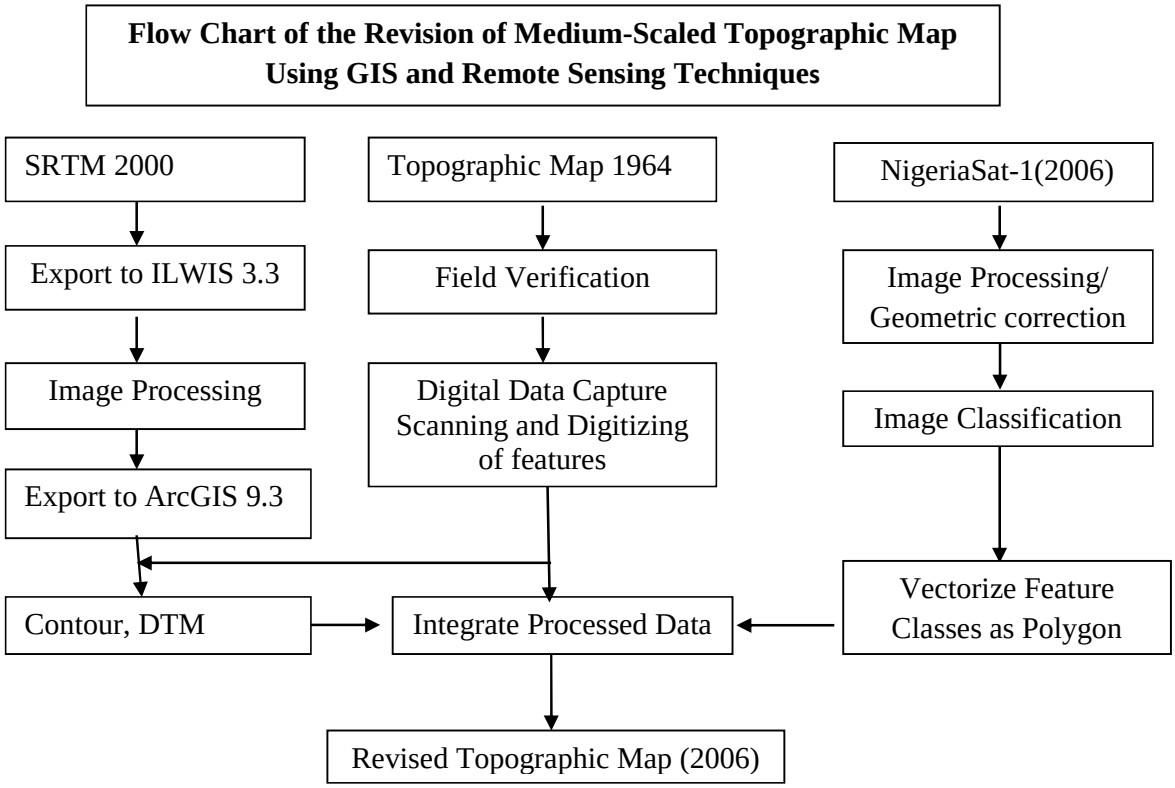

Figure 2.0: Flow chart for the revision of 1: 50000 Topographic Map of Onitsha Metropolis.

The study area needed for this study was extracted from the scanned and georeferenced (1964) 1:50000 Onitsha S.E topographic map. The area of interest was digitized in ArcGIS 9.3 environment. The resampled and georeferenced Landsat-7 ETM + of pixel size of 28.5m was used as a reference image to co-register the target image (NigeriaSat-1) to the coordinate system of Landsat-7 image (Igbokwe, 1995). Sub mapping, Resampling, color separation, maplist, sample set and Domain creation as representation of LULC were carried out in ILWIS 3.3.

The NigeriaSat-1 imagery was classified into Water bodies, Farmland, Vegetation, Open space and Built-up area using Supervised method of classification. The classes were vectorized into polygon using ArcGIS 9.3 software. Shuttle Radar Topography Mission (SRTM) of 2000 was downloaded from the internet. The downloaded SRTM image was used to generate the Contour using the spatial analyst extension of ArcGIS 9.3. The topography was also validated by comparing contour obtained from the SRTM image and contour obtained from Ground Control Points (GCPs) within the area. The vectorized classes of the images were integrated with SRTM contour and roads digitized from the NigeriaSat-1image and Ikonos image resampled to the resolution of the NigeriaSat-1(28m) to obtain the revised topographic map of Onitsha metropolis.

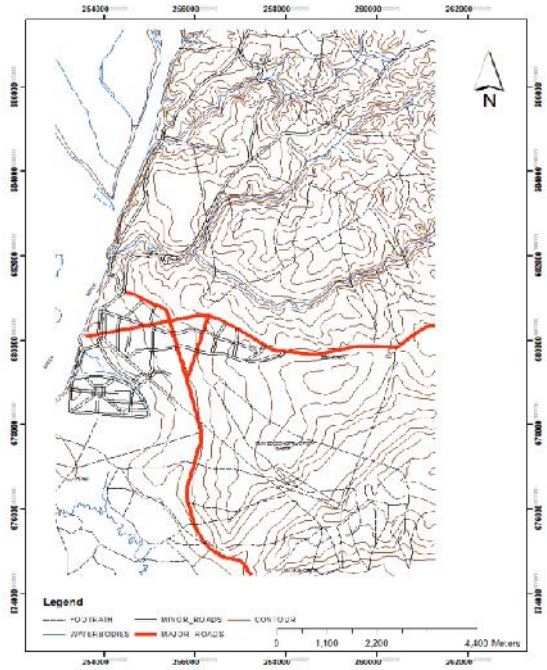

Figure 3.0: 1964 (1:50000) Digitized map of Onitsha Metropolis.

DISCUSSIONS AND RESULTS

The figure below shows the (1964) 1:50000 digitized map of Onitsha metropolis

The downloaded SRTM was used to generate the contour of the study area and the result is shown below.

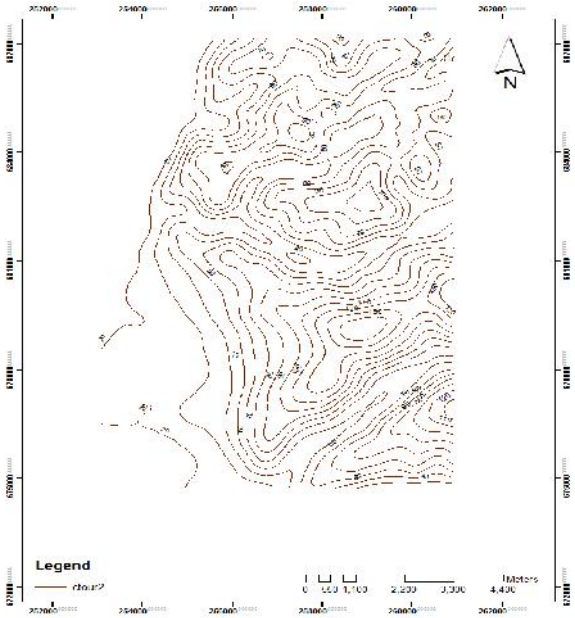

Figure 4.0: Contour generated from SRTM of 2000.

The result of the contour generated shows that area close to the River Niger has lower elevations and the elevation increases as we move farther away from the river. The accuracy of the contour was validated through field checks by using GPS to observe on some randomly selected Ground Control Points (GCPs). This was also validated using the contour obtained using x,y,z coordinates of randomly selected ground points.

The z or height value which is in ellipsoidal height was converted to orthometric height using the Global Geoid calculator available at . The GCPs coordinate was plotted on the SRTM contour. The result shows that there is no significant change in the topography from 2000 to 2006. The result of the classification exercise is presented in figure 5.0. The red area represent built-up areas, green area were the Vegetation, yellow was for farmland, blue indicate water bodies and white stood for open space. The result of the Classification process shows that Built-up Area accounted for the highest in landuse as 114 hectares which is about 30.05% of the total landuses in the study area while open space was the least at 7.51% of the total landuse.

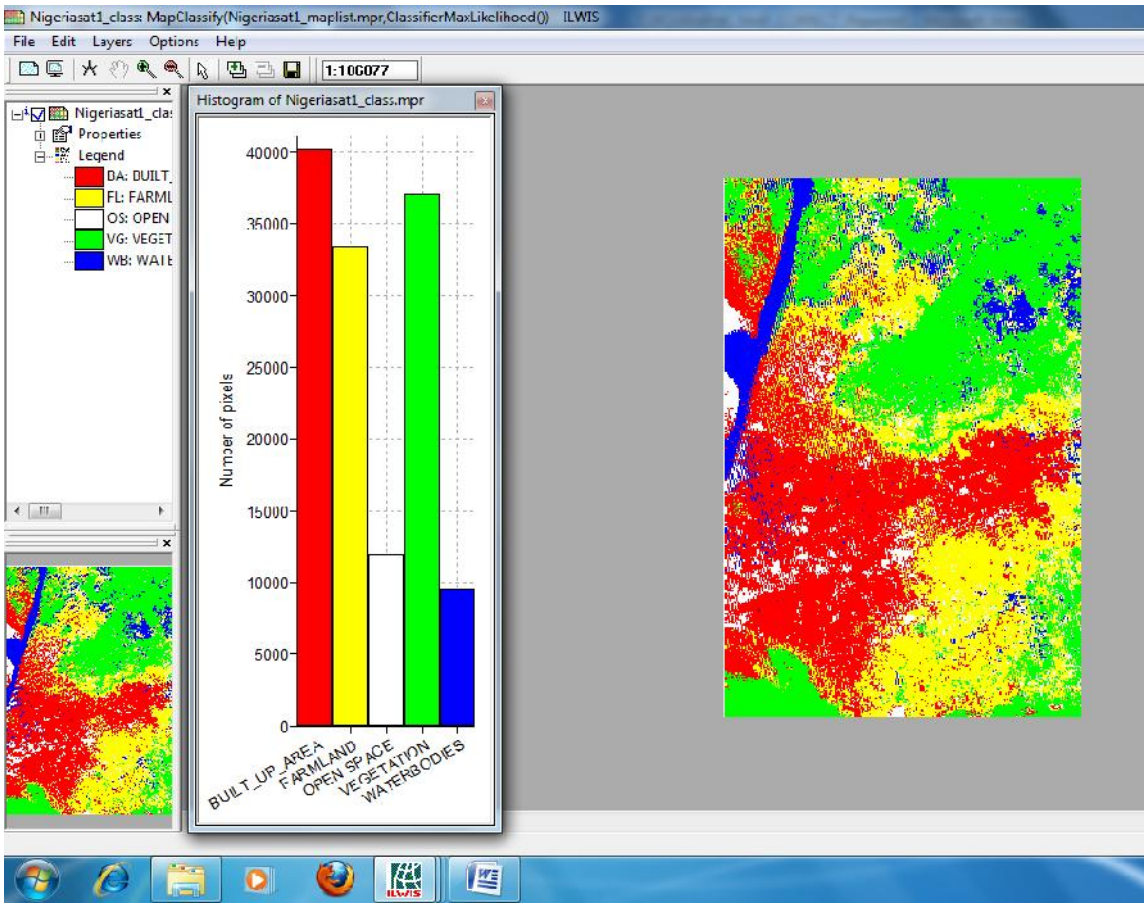

Figure 5.0: Classified result of the Onitsha Metropolis NigeriaSat-1 image (2006).

The classified images were exported to ArcGIS 9.3 where they were vectorized into polygon and the result is presented in figure 6.0

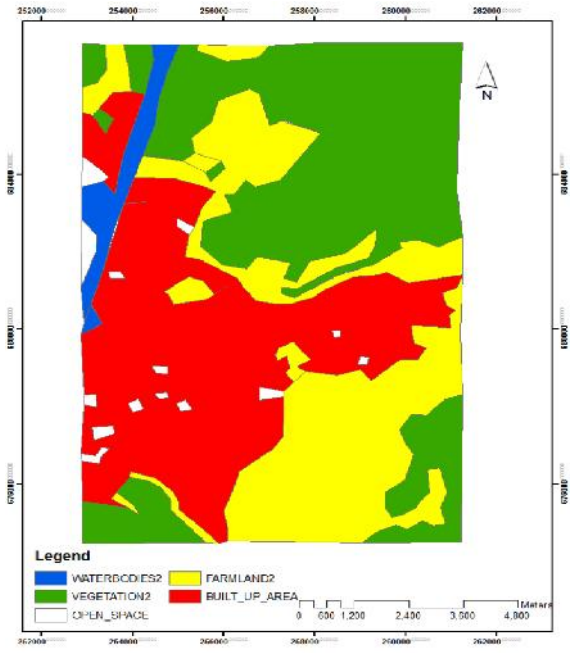

Figure 6.0: Vectorized classes of NigeriaSat-1 image (2006)

The vectorized classes of the images were integrated with SRTM data and roads digitized from the satellite image to obtain the revised topographic map of Onitsha metropolis.

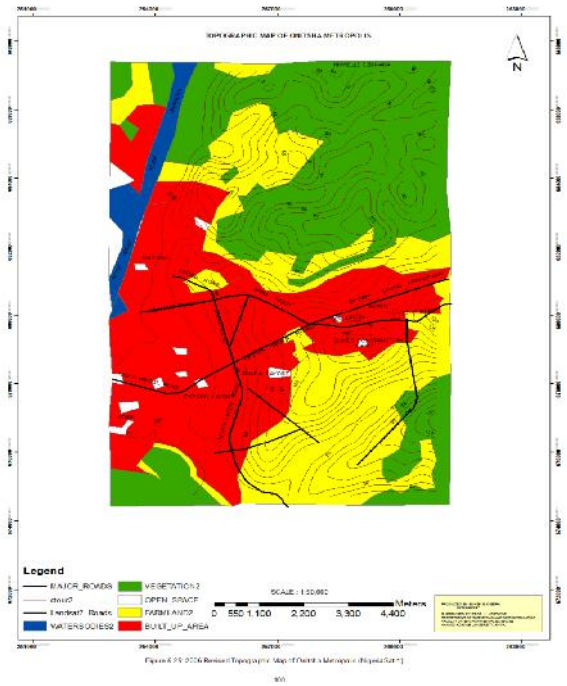

Figure 8.0: Revised Topographic Map of Onitsha Metropolis (2006)

CONCLUSION

The use of remote sensing and GIS had been demonstrated in this study as an effective tool for revision of 1:50000 topographic map. 32m resolution NigeriaSat-1 of date (2006) were used to revise (1964) 1:50000 topographic map of Onitsha metropolis. Overall classification accuracy of 86.90% was achieved, which is higher than the minimum accuracy of 85% required for effective land cover analysis and modeling. (Ezeomedo, 2012). NigeriaSat-1, a medium resolution satellite image performed well in this study and thus can be used successfully in medium scaled mapping. Also, the homogeneous spectral characteristics of features identified in the image could have contributed to the better performance of the classification process. The result shows a high concentration of human activities close to the river Niger as regards to the Built up Area in the classification result. Farmland and vegetation occupied large portion of the Northern part of the classification maps. This area (3.3 towards Nkwelle Ezunaka town) is a relatively growing settlement in Onitsha. Field verification shows that these areas were characterized by relatively scattered buildings. A conclusion derivable from these is that the areas can be used for future development and planning. Further analysis showed that a lot of changes had happened from 1964 to 2006.

RECOMMENDATIONS

Based on the results and analysis obtained, the following recommendations are made:

i. Government should expedite action on archiving of NigeriaSat-2 and Nigeria Sat-X images of the whole country so as to provide satellite image data of higher resolution, which can facilitate Map Revision in the country.

ii. Use of 1964 1:50000 topographic map series should be discouraged by map users Rather revision of 1:50000 topographic map coverage of the country should be carried out without further delay

iii. This study has highlighted the importance and uses of topographic maps. It is recommended that Nigeria adopts 1:25,000 Topographic Map as the Base Map for the country. The Federal Government should embark on Nationwide Topographic Mapping of the country at 1:25,000. Scale

iv. A major aspect of Topographic Mapping is availability of controls. In this study, we relied mostly on GPS observations to locate features of interest. The Government should ensure that geodetic controls are provided in all Urban Areas for mapping purposes.

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