ABSTRACT
The discharge of a river is the quantity of water flowing through its cross section in a second. Rivers are characterized with dynamic behaviours, which are often result to changes in widths, depths, velocity, discharges, and sediments transportation as well as topography. Some of these changes in the marine environment are highly dynamic and often subsurface and can only be observed with special instruments, which operate below the water surface to be able to detect these changes. This study aimed at exploring the relevance of survey technique in effective harnessing of River Gongola potentials to improve the supply of water to Ashaka Cement Company, Gombe State. The data gathered were analyzed in GIS application software ArcGIS 10.2. A total volume of the water discharge is 38.79 m$^3$/s, a total velocity of 2.97 m/s and total area of 104.90 m$^2$. The Annual Daily Maximum and Minimum Water Level of 247.01 m (AMSL) and 240.69 m (AMSL) recorded in 1986 and 1985 respectively. The result of the processed and analyzed data revealed that River Gongola can discharge 139,644 m$^3$/Hour (335,145,614 m$^3$/Day). The study recommends adoption of a reengineered surveying of the inland waters, acquisition of modern hydrographic survey instruments and GIS software, adequate training of staff of the agencies in charge to improve service delivery for sustainable development.

Keywords: Inland water, Water discharge, Potentials, Hydrographic surveying, Sustainable development,
behaviours ranging from overflow (flooding), siltation / sedimentation and seasonal fluctuation. It poses serious threat to human lives and properties especially when it overflows its banks. However, it provides great alleviation during drought periods by making available water for domestic, irrigation and industrial uses. The dynamic natures of this river call for a constant periodic review of its nautical chart, which will enhance control measures for its adverse effects and proper harnessment of its potentials.

The accurate determination of water discharge is essential in the planning of channel and reservoir capacity expansion for dams, hydro-electric generation, industrial and domestic water supply, proper erosion and flood control. (Ojinnaka, 2007).

Aim and Objectives
To employ survey techniques to explore the potentials of the upper part of River Gongola for adequate water supply to Ashaka Cement Factory, Gombe Nigeria. This aim would be achieved via the following specific objectives;

i. To determine the velocity of the flow of water at the section designated for the generation of water to the factory
ii. To determine the cross sectional area of the river
iii. To determine depths of water at specific interval along the river vertical
iv. To determine the width of the river
v. To determine the volume of water discharge of the river

The Study Area

The study was carried out on a section of river Gongola which lies Latitudes (10° 55' 52'' N and 10° 56' 13'' N) North of the Equator, and Longitudes (11° 31' 32''E and 11° 31' 50''E) East of the Greenwich Meridian.

Fig.1a: Map of Nigeria showing States. Fig.1b: Photograph showing River Gongola

PROSPECT OF HYDROGRAPHIC SURVEYING IN THE DEVELOPING NATION WITH FOCUS ON NIGERIA
In Nigeria, the power of charting is vested on the Nigeria Port Authority and the Inland Water Way Departments, but today several agencies and organizations resort to surveying and charting of some section of waters of the operations. Hydrographic surveying activities in Nigeria are usually more in the coastal states and mostly limited to the mouth of the estuaries, major rivers channel and sea entrance of
importance, such as the Lagos harbor, Calabar port, Warri port, Port Harcourt ports, Escarvos rivers, Forcados rivers and Bonny rivers. The importance of proper hydrographic surveying of the Nigeria Inland waters especially in the Northern parts is further stressed by the facts that the regional lacks adequate rainfalls, hence most of the farming, electric-hydro projects, dams and road construction, other industrial and domestic activities depend on the Inland waters. Unfortunately, the Northern States of Nigeria lack adequate modern hydrographic equipment and operational hydrographic offices to sufficiently survey its Inland waters in order to effectively harness its potentials.

Every maritime nations or coastal states in accordance with the United Nations Conference on the Law of the Sea (UNCLOS) 1958 in Geneva need reliable nautical charts of all its claimed waters for the safety of shipping in their waters if full potentials of its offshore national assets is to be realized. (Maling, 1989) The law of the sea conference was held recently in Singapore based on the argument between coastal states and International shipping that the latter should take its share in paying for some of the services provided by the coastal states that it enjoys. This was the second conference on the subject dealing with the straits of Malacca and Singapore, (Caris, 2000). Much of the sea bed and riverbed is still neither surveyed at all or where it is surveyed, is not to modern standards, although this requirement is gaining much higher profile in most developed countries following the advancement in technology and adoption of the United Nation Convention on the law of the sea (UNCLOS, 1982, Clarke,1998).The absence of National Hydrographic Office (NHOs) in the developing nation has lead to the problem of unorganized chart production in these countries. This lapse has resulted in the continuous use of obsolete charts produced by their colonial masters many decades ago and consequent imposition of compulsory Pilotage on, (Ojinnaka, 1997). Attempts to fill the gaps created by the exit of the colonial masters lead to the commissioning of contract for production of Local Chart by the Nigerian ports Authority (NPA) and the inland water ways Department (IWD) unfortunately despite the existence of the local charts Pilotage has remained compulsory on almost all approach channels in Nigerian waters. In much of the developing countries of the world today, hydrographic surveying activities and chart production is still presented in form of paper charts, unfortunately just like land use land cover maps, the time interval between data collection and chart production renders every chart obsolete as it rolls off the printing machine due to the dynamic nature of the coastal environment. However in the advent of the Electronic Chart Display and Information System (ECDIS), charts can now be produced on line and updating is a continuous process. Much of coastal States of the developed nations adopt ECDIS for charting of their waters and have developed a fully operational National Hydrographic Offices, whereas most of the developing countries have no operational National Hydrographic Offices (NHO) nor acquired Electronic Chart Display and Information System (ECDIS) for charting of their coastal waters.

**Research Methodology**

The methods adopted in this study include data acquisition, data conversion, data processing, data analysis and result presentation.

**Data acquisition**

The study adopts the field and social survey methods for the acquisition of spatial and non-spatial data of the study area. The study employs a Bray Stroke Current Meter, a hand-held GPS receiver (Garmin), Automatic Level, a Suspension Derrick, a Columbus Sinker and a Canoe to acquire the spatial data used in this study, whereas the non-spatial data of the study area were sourced from the Upper Benue River Basin Development Authority (UBRBDA) Yola, Adamawa State, and Ashaka Cement Factory, Ashaka, Gombe State.

**Data Conversion**

This includes all the processing performed on the acquired data in order transform them into a format useful for the study. The procedures performed on the data include data capture and transfer, geo-referencing and digitalization using the on-screen digitizing capabilities of ArcGIS 10.2 software.

**Calculation of depth reduction**

\[
\text{Reduced depth} = (\text{zero gauge level reading} + \text{observed depth}) - \text{Datum gauge benchmark reading}
\]

**Calculation of water discharge (Mean-Section Method)**
Cross-sectional discharge along a particular vertical

\[ v_{m1} = V_1 + V_2, \quad d_{m1} = d_1 + d_2, \quad q_i = v_{m1} \times d_{m1} \times b_i \]

In general

\[ v_{m1} = \frac{V_i + V_{i+1}}{2} \text{ ms}^{-1}, \quad d_{m1} = d_i + d_{i+1} \text{ m}, \quad q_i = v_{m1} \times d_{m1} \times b_i \text{ (m}^3\text{s}^{-1}) \]

**Total discharge of entire channel of all verticals.**

\[ Q = \text{Sum q}_i \text{ (m}^3\text{s}^{-1}) \] (Ojinnaka, 2007)

**Data Processing**

The data captured and converted were processed in the ESRI ArcGIS 10.2 application software and using the statistical tool of the Microsoft application software

**Data Analysis**

The processed data were analyzed in the ESRI ArcGIS 10.2 application software and using the statistical tool of the Microsoft application software

**Results Presentation**

The results of the processed and analyzed data were presented in form of calculations, tables, graphs and maps.

Table 1: Survey data acquired on River Gongola at Ashaka
Fig. 2: Chart showing cross-section of water level of River Gongola at Ashaka

Fig. 3: Chart showing the minimum gauge of water level of River Gongola at Ashaka
Fig. 4: Chart showing maximum gauge of water level of River Gongola at Ashaka

Conclusion and Recommendations

Conclusion
It further demonstrates the efficiency and capability of hydrographic surveying method in exploring the potentials of the Inland water for sustainable development.

Recommendations
The study recommends adoption of a reengineered surveying of the inland waters, acquisition of modern hydrographic survey instruments and GIS software, development of National Hydrographic Offices, Inland Water Way Department and the River Basin Development Authority, adequate training of staff to improve service delivery and to make land administration a nodal point in order to reform the economy of the nation.
References
FIG (1998). Hydrography: Developing the Profession in the Developing World. Published by the International Federation of Surveyors