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Review

Groundwater flow direction in Ndokwa-East local government area of Delta state, Nigeria

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The Global Positioning System (G.P.S) was used to measure the longitudes, latitudes and elevations above mean sea level at 11 locations evenly spread within Ndokwa-East Local Government Area of Delta State. The water table contour map of the study area revealed that groundwater flow direction is moderately toward the south (Aboh) and extensively towards the North-Western parts of the Region (Beneku and Ashaka). Based on the flow pattern of the aquifer system in Ndokwa-East Local Government Area, more effort should be made towards entrenching eco-friendly practices in the Eastern Regions of Okpai-Oluchi and the West Central Regions of Igbuku in order to minimize the contamination of groundwater supply to the other regions especially the North-Western zone. The research paints a clear picture of the flow system within the study area, thereby creating awareness on the possible areas that could be adversely affected in the event of groundwater contamination, it also recommend that wells and boreholes for rural and urban water supply should be sited in the South-western through the central onto the eastern regions and not within the North-Western parts of Ndokwa-East local government area.

Key words: Ndokwa east, groundwater, flow direction, elevation, water table and contamination.

INTRODUCTION

Although, pure water is odourless, colourless and tasteless, naturally occurring water picks up colour and taste from substances in its environment (Wehrmann, 2007). Without water, life on earth would be impossible, hence throughout history; man has consistently migrated towards and consequently settled within the vicinity of some source of water supply. This is evident from the fact that the capital cities of most ancient and modern civilisations are located near or around a river, lake or the coast.

As the population of human settlements grew, so did the demand for water, which unfortunately became more and more unfit for human consumption, a situation resulting from pollution due to overpopulation, overuse and misuse. In an effort to establish a lasting solution to this water problems, man has gone in search for alternative sources and methods to provide for himself, his plants and animals with clean and potable water. Some of these alternative sources include harvesting water from the rain and extracting water from hand or machine dug wells. As groundwater is being utilized, certain issues such as those of pollution or contamination arise. Given that water always flows from a region of higher head to a region of lower head (Wehrmann, 2007), it is found that groundwater use within an area at a higher water level directly affects the quality of water available to people living in regions of lower water levels. To this end, it becomes necessary to investigate the pattern in which groundwater flows so as to ascertain the pattern of distribution of contaminants hence proffer reliable recommendations.

Man has attempted in diverse ways to explain some of the basic issues associated with groundwater resources. These issues were mainly philosophical questions like;

Table 1. Results obtained at the end of field survey.

S/N	Location	Longitude	Latitude	Elevation	Depth to water (m)	Static water level (m)
1	Abalagada	6° 32′ 44″	5° 37′ 25″	15.00	3.08	11.92
2	Aboh	6° 31′ 28″	5° 33′ 07″	12.80	3.66	9.14
3	Asemoku	6° 31′ 19″	5° 40′ 34″	14.94	3.69	11.25
4	Ashaka	6° 24′ 10″	5° 38′ 37″	10.67	8.23	2.44
5	Beneku	6° 27′ 03″	5° 41′ 01″	10.57	7.62	2.95
6	Igbuku	6° 24′ 34″	5° 36′ 40″	20.73	9.14	11.59
7	Iseonorkpo	6° 32′ 18″	5° 35′ 33″	14.22	3.40	10.82
8	Oko	6° 26′ 35″	5° 35′ 15″	17.90	7.39	10.51
9	Okpai-Oluchi	6° 33′ 23″	5° 41′ 14″	17.09	1.56	15.53
10	Umu-Ewere	6° 28′ 20″	5° 34′ 34″	15.95	5.97	9.98
11	Ushie	6° 27′ 14″	5° 38′ 31″	13.82	8.29	5.53

where does groundwater come from? How does it occur? Is it static or dynamic? If it is dynamic, what factors are responsible for its movement? How fast does it flow and in what direction?

These questions and many more led certain Greek and Roman philosophers to attempt explanations for the origin, occurrence and movement of groundwater. Most of these explanations were fictitious and unrealistic, some were nearly correct accounts (Fetter, 2001; Todd, 2005).

The most notable contribution during this period was based on the work of French hydraulic engineer, Henry Darcy (1803 to 1858) who studied the movement of water through sand. His treatise of 1856 defined the relation now known as Darcy's Law, which governs groundwater flow in most alluvial and sedimentary formations (Fetter, 2001; Todd, 2005; Water Encyclopedia, 2010).

By the end of the nineteenth century, tremendous advances had been made towards the understanding of the nature and behaviour of groundwater resources through the work of American enthusiasts like O.E. Meinzer who through his zeal and dynamic leadership stimulated many in the quest for knowledge on groundwater (Fetter, 2001; Todd, 2005).

The purpose of this study is to determine the groundwater flow direction within evenly distributed regions of Ndokwa-East Local Government Area of Delta State hence determine the locations or regions that are likely to suffer more due to groundwater pollution. Delta State hence determines the locations or regions that are likely to suffer more due to groundwater pollution.

LOCATION OF THE STUDY AREA

The region covered under this study lie between latitudes 5.55 and 5.69° North and longitudes 6.40 and 6.56° East. The major communities within this region include; Abalagada, Aboh, Asemoku, Ashaka, Beneku, Igbuku, Iseonorkpo, Oko, Okpai-Oluchi, Umu-Ewere and Ushie. The region is defined as comprising the area covered by the Natural Delta of the River Niger (NDDC, 2005) (Table 1).

INTERPRETATION OF RESULT

The results obtained from the field work were used to generate base contour map and flow direction of the study area. Both manual and computer aided methods were adopted in performing this task.

Figures 1 and 2 represent the results obtained for the water table contour map of the study area and that for different colours through the use of surfer 8 program.

INTERPRETATION OF RESULTS

The results obtained the computer aided contouring of the aquifer system within the study area shows that groundwater flow mostly from north-eastern corner through the central regions to the north-west. The results also indicate that inordinate land use activities (such that could lead to land/soil pollution) in the region would be more detrimental for communities lying within the north-western zones of the study area.

CONCLUSION

From the contents of the preceding sections, it is found that the behaviour of subsurface water must not necessarily reflect that of the surface, thus knowledge of subsurface water behaviour becomes an important puzzle that requires a great deal of devotion, skill and rigorous research to fully understand.

This knowledge enables government, corporate organization and individuals to properly develop the various water resources available to them, particularly groundwater.

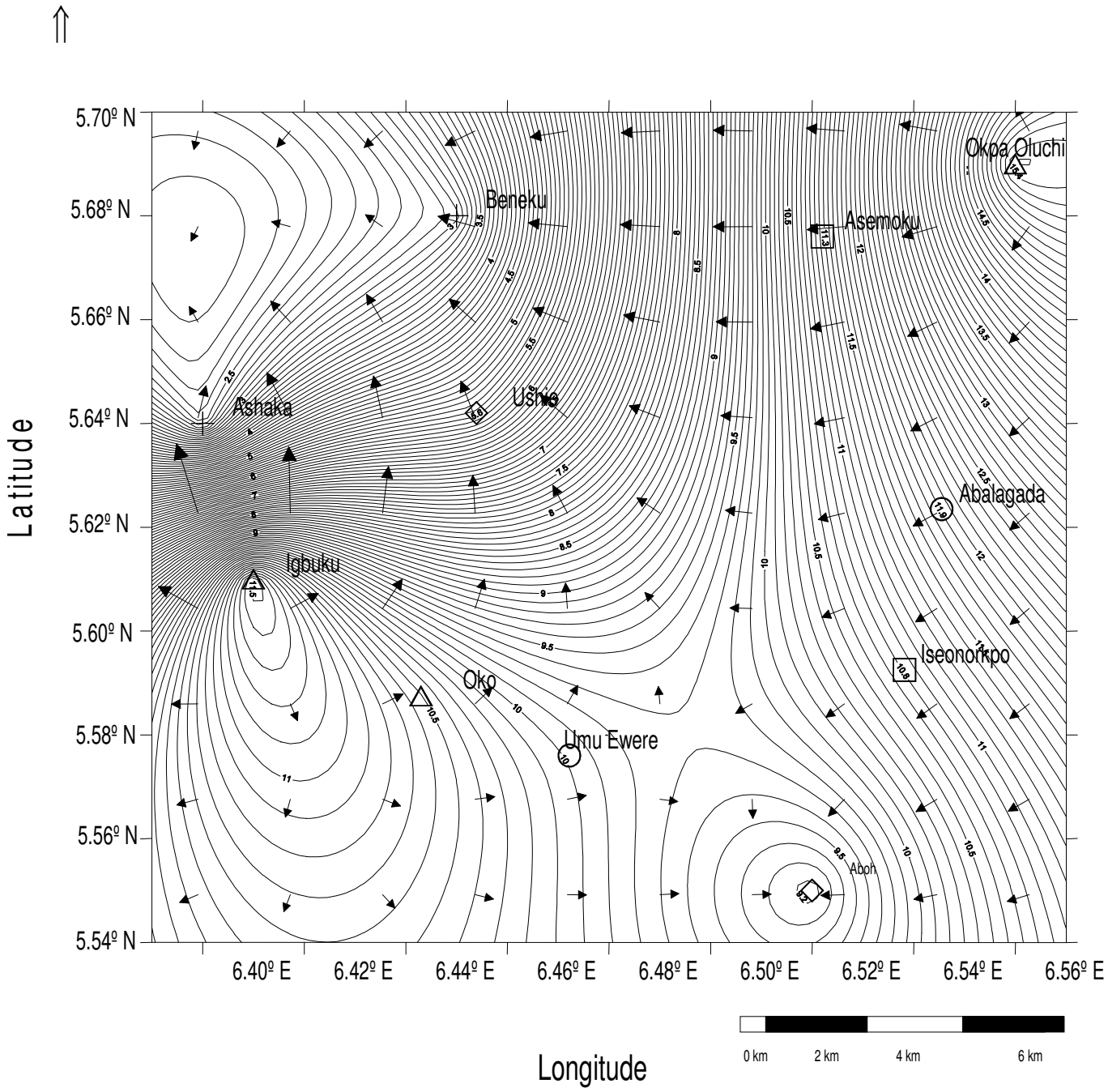

Figure 1. Water table contour map of the study area showing the flow direction = the major towns in Ndokwa East.

RECOMMENDATION

Stakeholders in the given region should ensure that eco-friendly land use practices are encouraged while harmful practices are minimized so as to avoid pollution which could lead to the contamination of the groundwater resources available within the study area particularly in the north-western regions since the aquifer is not

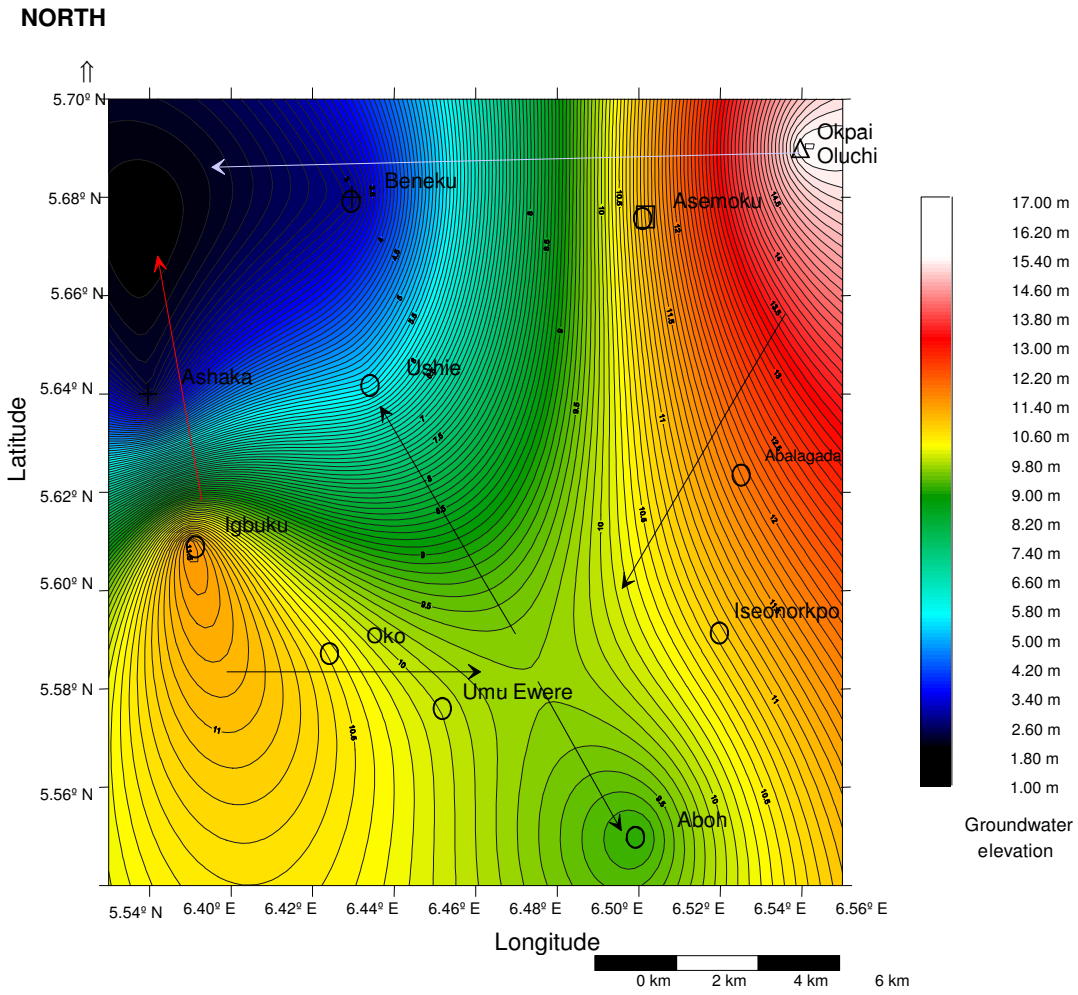

Figure 2. Water table contour map of the study area using colours = the major towns in Ndokwa East.

confined (Oseji et al., 2005, 2006, 2007).

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