DETERMINATION OF GROUNDWATER FLOW DIRECTION AT EMU AND OGUME KINGDOMS/ NIGERIA

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ABSTRACT

The global positioning system (GPS) was used to measure the longitudes, latitudes and elevations above mean sea level at eight (8) locations evenly spread within the major communities in Emu and Ogume kingdom. The water elevation contour map of the study area revealed that groundwater flow toward the South and South eastern part of Emu and Ogume kingdoms. Based on the flow pattern of the aquifer system in Emu and Ogume Kingdoms, dumpsites should be sited in the south and southeastern part of the area, and not in the north, west and eastern region. This was to minimize groundwater contamination. This research informed the people of Emu and Ogume kingdoms on the possible areas dumpsites could be sited in order to reduce groundwater contamination. it also recommended that boreholes for potable water supply be sited in the North, West and eastern parts of the communities and not within the south and southeastern parts.

Keywords: *groundwater, flow direction, dumpsites, borehole Emu and Ogume.*

1. INTRODUCTION

Water is of fundamental importance to plants and animals particularly man. It is very vital in maintaining life processes and growth (Oseji et al 2005). Potable water is not commonly found and its provision limits the setting up of villages and towns to places where supply exists (Shankar, 1994 and Huisman, 1966).

Groundwater is commonly understood to mean water occupying all the voids within a geologic stratum. (Deborah et al, 1996).It is not usually static but flows through the rock. The ease with which water can flow through a rock mass depends on a combination of the size of the pores and the degree to which they are inter-connected (Neilson D.M. 1991). Most local groundwater supply in Emu and Ogume kingdoms comes from an unconfined aquifer made up of loose soil materials such as sands, gravels and flood plain deposits left by stream and rivers (Oseji et al, 2005; Oseji et al, 2006; Oseji, 2007).

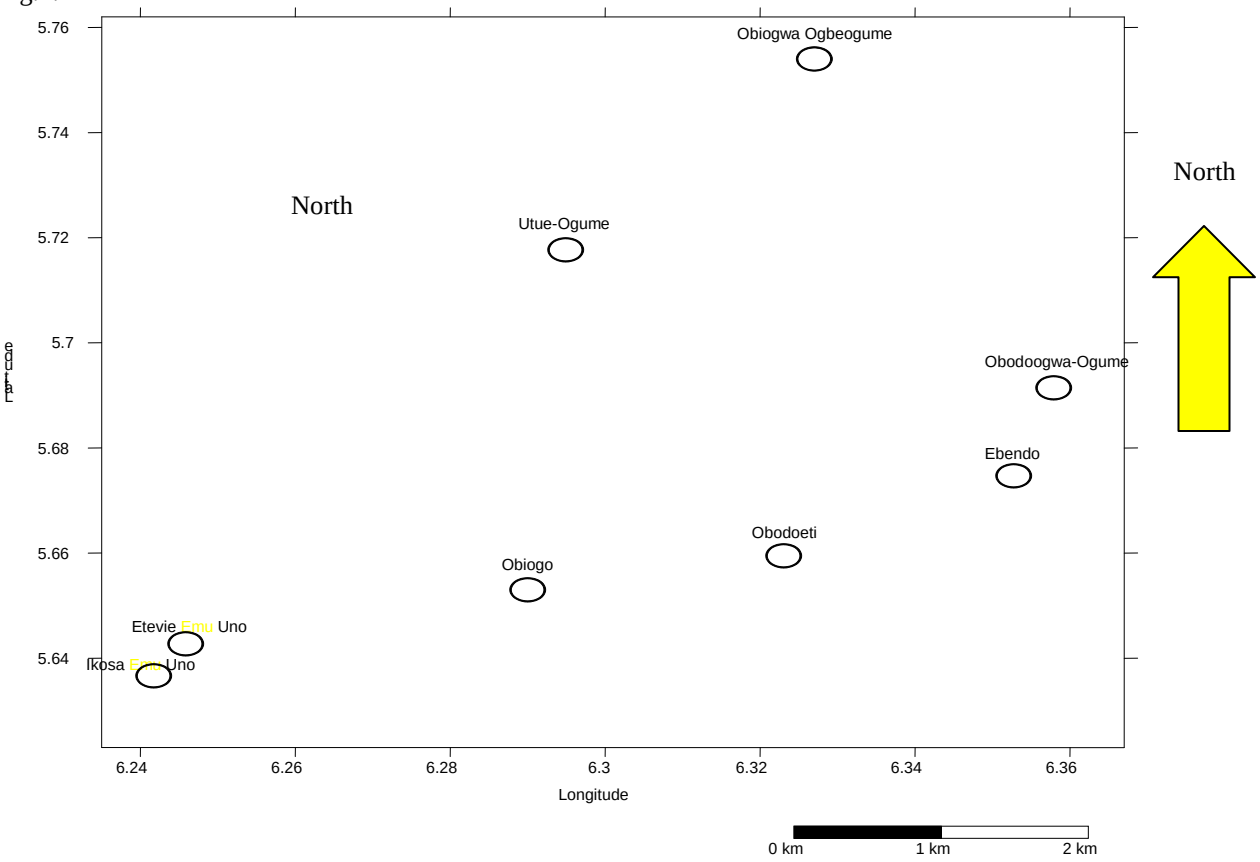
The depth to water table can be determined by digging a hole progressively deeper into the ground, the depth at which groundwater begins to seep into the hole indicates that the surrounding material is saturated with water and this marks the height of the local water (water table) where there is no surface water, (Buddemeier and schloss, 2000). The water table varies in depth according to local topography and prevailing climate. The depth is generally established by a long term balanced between recharges despite seasonal climatic fluctuations. The water table is not flat as its name implies. It is the top of the water surface in the saturated part of an aquifer. It has peaks and valleys that echo the shape of the land above it. Groundwater usually flows toward, and eventually drains into stream, rivers, lakes, creeks, ponds and boreholes. The flow of groundwater in aquifer does not always reflect the flow of water on the surface. It is therefore necessary to know the direction of groundwater flow and take steps to ensure that land use activities in the recharge area will not pose a threat to the quality of the groundwater (Freeze and Cherry, 2002).

Furthermore, it is also important to know if the groundwater system is a recharge or discharge system (gaining type or losing type). The quality of water is affected by the quality of groundwater entering the system of water supply in the borehole (Shwille, 2000). This is because the water table elevation is approximately the same as the gaining borehole surface elevation; Both elevations may be used to construct water table maps (contour) and to predict groundwater flow direction.

2. LOCATION OF THE STUDY AREA

Ogume and Emu kingdoms are in Ndokwa west local government area of Delta State. They are in the south eastern region of the state, situated in the South-south region of Nigeria and lies between latitudes 5^{o} 48^{1}N and 5^{o} 60^{1}N and longitudes 6^{o} 08E. and $6^{0}32^{1}$E. Ogume has common boundary in North with Onicha Ukwuani and Obiaruku in the Northwest. Emu has a common boundary with Umusadege and Ashaka in East. The important streams in the region are Olor, Atur Utaniko and Odibo. Others are Ifru-ude, Edu and Abata in Utue-Ogume. The stream in Utue-Ogume

usually dries up in the dry season. The base map of the communities in Ogume and Emu Kingdoms are shown in fig.1.



= The communities in Ogume and Emu Kingdoms

Fig. 1 Base Map of Emu and Ogume Communities

3. MATERIALS AND METHODS/METHODOLOGY

Three major stages of field procedures were used in this research: Eight holes evenly distributed and spaced 7.5 km apart were drilled within Emu and Ogume kingdoms. The depth at which water began to seep into the hole would indicate that the surrounding material was saturated with water and this would mark the depth to water level in the well.

With the aid of a meter rule and tape, the depths to the water level in the hand dug wells were measured and recorded. The Global positioning system (GPS) of type 310 was used to measure the longitude, latitude and the surface elevations with respect to the mean sea level to the lowest surface within the earth. The surface elevation at different point, varied. This uniform water level coincided with static water level in the case of an unconfined aquifer while it was the piezometric surface if the aquifer was confined (Buddermier and Schloss 2000)

Let D_{HDW} = the depth from the surface of the earth to the water level in the hand-dug well (Direct Bore hole logging)

E = the surface elevation with respect to the mean sea level S_{wl} = the true or uniform water level otherwise known as the static water level in the case of an unconfined aquifer then

$S_{wl} = E - D_{HDW}$

The values of the static water levels were contoured on the map of Emu and Ogume Kingdoms. These lines represented the water table contours. According to Buddermeier and Schloss (2000), ground water would flow from the highest values of contour lines to the lowest values in a direction perpendicular to the contour lines.

4. RESULTS AND DISCUSSION

The values of the static water levels were contoured on the map of Emu and Ogume kingdoms. Equal values of static water levels were joined together very carefully such that none of the lines overlapped or cut across each other. This was improved upon by using surfer 8 software as shown in Fig. 2. The contour map of Emu and Ogume

Kingdoms using colour to represents the static water levels is shown in Fig. 3, while the wire frame of Emu and Ogume Kingdom in three dimension is also shown in Fig. 4. Flow pattern of the aquifer system in Emu and Ogume Kingdoms revealed that groundwater flow direction was toward the South and South eastern parts of the area. Therefore, ground water moved down gradually to recharge the Ase Creek. Ase creek was gaining creek. Although, from the eastern part of the contour map, the Ase creek could be described as a losing creek at this point since it would lose water to the location around there.

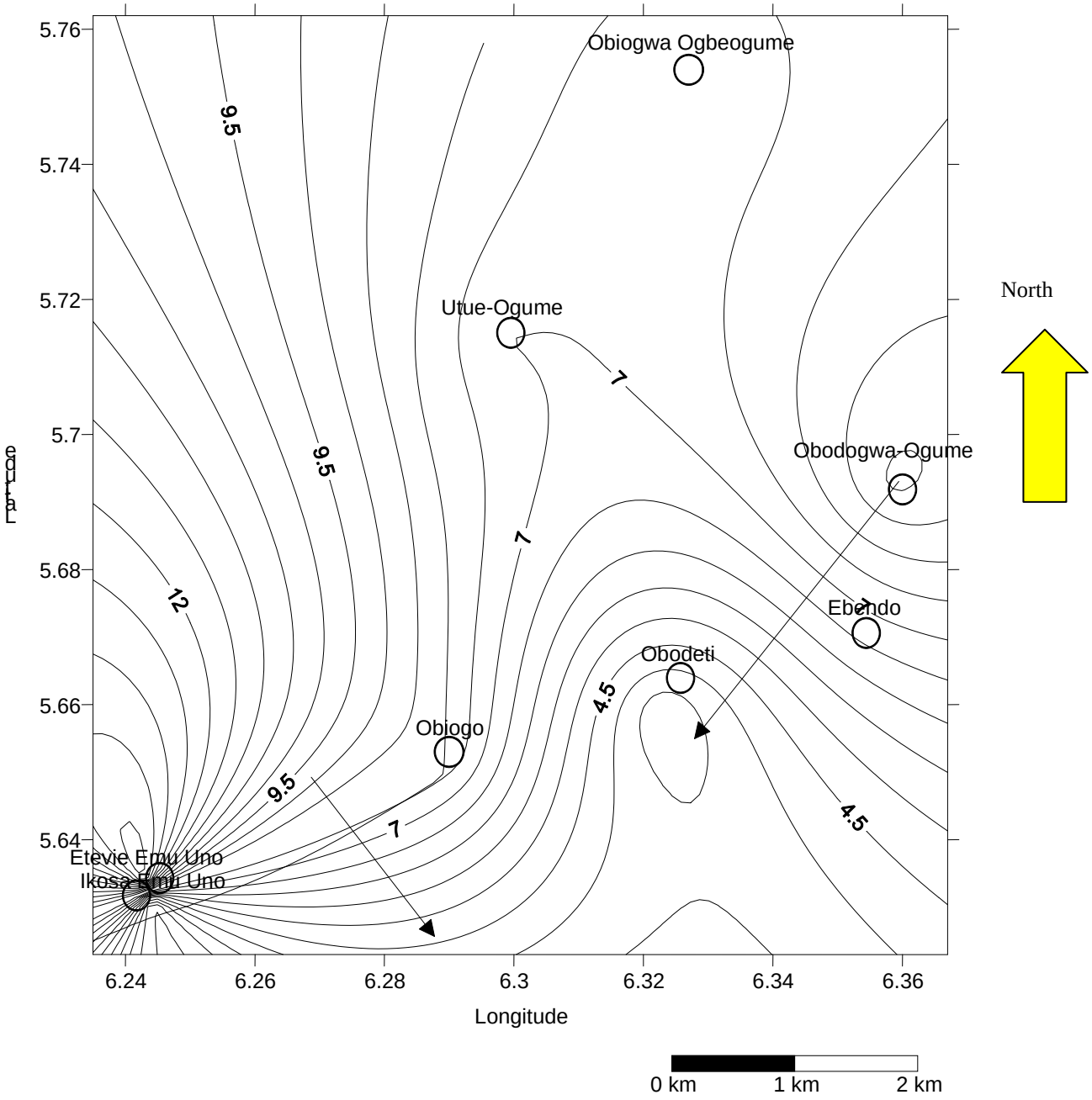


Fig. 2: Contour Map of Emu and Ogume Kingdom showing Groundwater flow direction in two dimensions using suffer 8 Software.

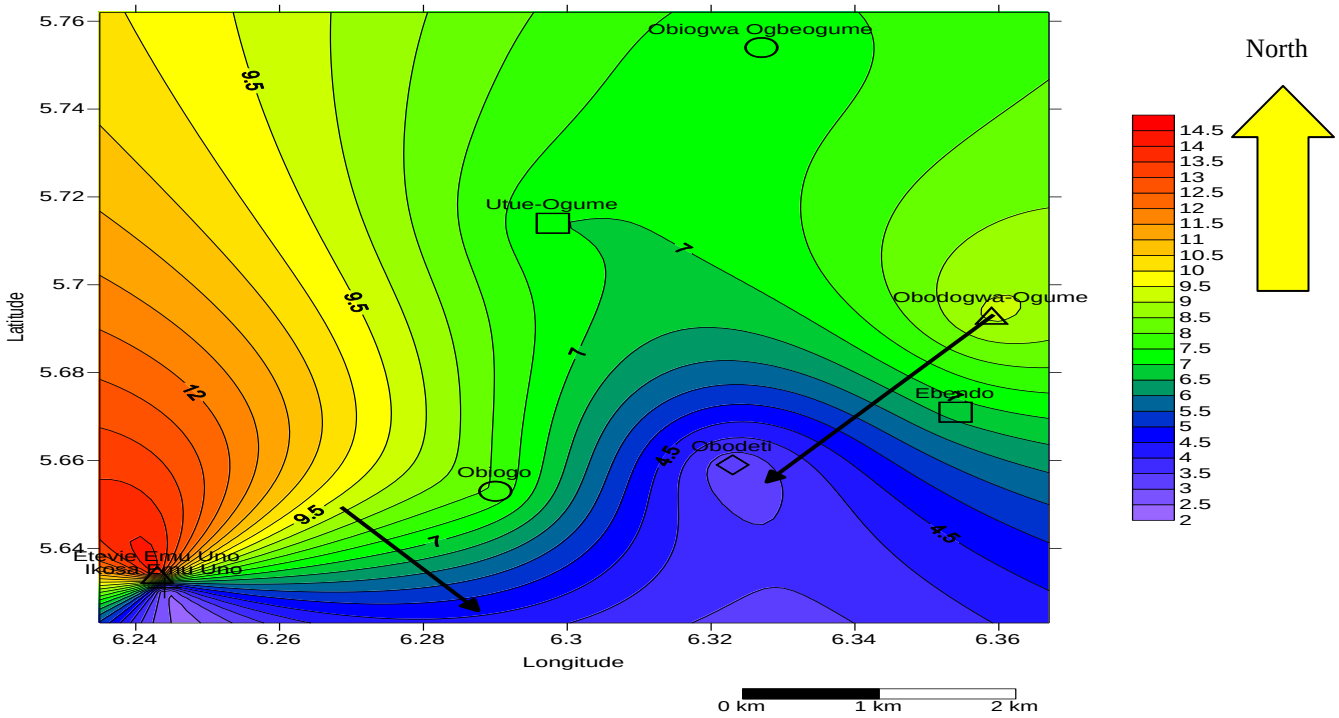


Fig. 3: Color Contour Map of Emu and Ogume Kingdom showing Groundwater Flow Direction in Two dimensions with contour intensity of 0.50

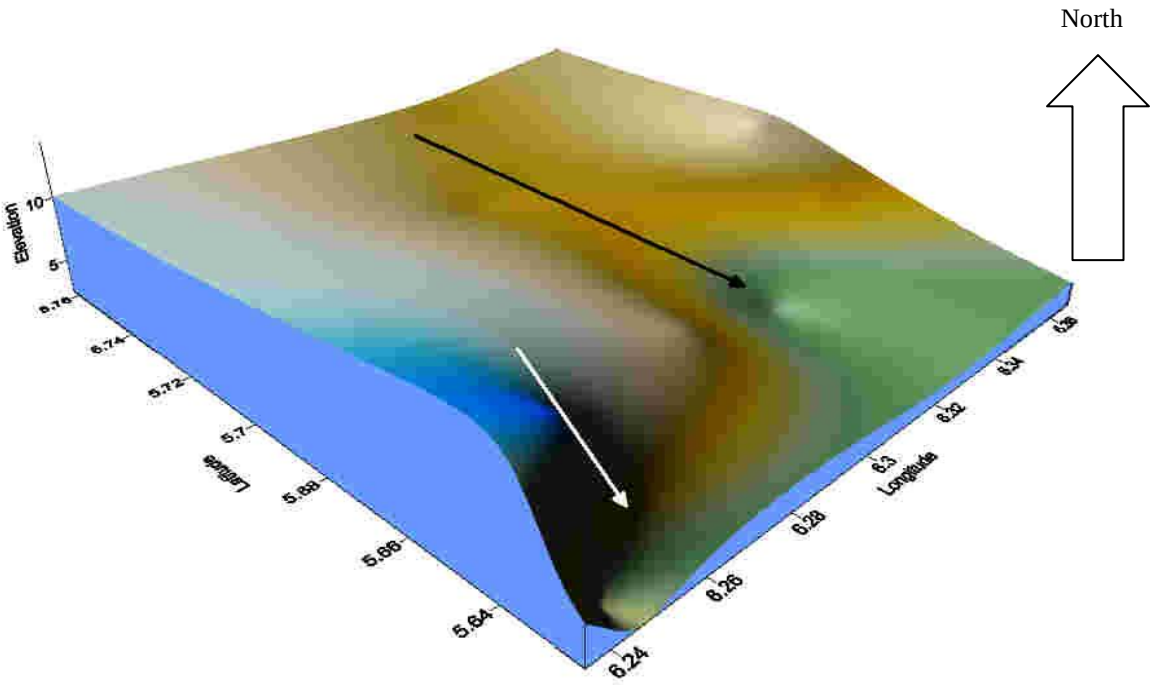


Fig. 4: The Contour Map of Emu and Ogume Kingdoms showing Groundwater Flow Direction in Three Dimensions with contour intensity of 0.50

5. CONCLUSION:

The water elevation contour map of Emu and Ogume Kingdom revealed that groundwater flow direction was toward the South eastern and south westerns part of the region. Among the sources of groundwater pollution were leachates from dumpsites and the health of inhabitants' stand at risk if leachates are allowed to communicate with groundwater.

6. RECOMMENDATIONS

Based on the flow pattern of the aquifer system, it was therefore recommended that dumpsites should be sited within the south and southeastern part of the area and not in the North, west and eastern regions in order to minimize groundwater contamination by dumpsites.

The research did not only show the flow system in Emu and Ogume Kingdom, it also created awareness on the possible area dumpsite could be sited in order to minimize groundwater contamination. The research also recommended that borehole for potable water supply should be sited in the north, west and eastern region and not within the south and south eastern parts of Emu and Ogume kingdom.

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