GROUNDWATER ASSESSMENT BASED ON BACTERIOLOGICAL ANALYSIS BY H2S TEST IN ANY SHOUK AND AL SALAAM CAMPS, NORTH DARFUR STATE, SUDAN

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ABSTRACT

The main objective of the study is to assess the groundwater quality based on bacterial properties by checking the presence, absence or concentrations of indicator bacteria in study area. Twenty (20) water samples were collected during field trips for bacteriological analyses, from hand pumps and boreholes which distributed throughout the study area; the analyses have been done at Water and Environmental Sanitation Project laboratory (WES) at Al Fashir town. All water samples were analyzed, according to standard methods for water examination by using Hydrogen sulfide (H_2S) test. GIS technique was used to construct water sample location sites and Strater Demo-4 used for great cross-sections. Surfer-10 software used for constructs maps of contours water level, wells yield and the groundwater flow direction. Electronic Automatic Logger and water level indicators devices used for measured groundwater level. The results of all samples of water show that have negative results/no indication of contamination and the groundwater in the study area is good and excellent for domestic uses. The groundwater bearing formation comprises mainly of the basement rocks (weathered and fractured) and alluvial deposits of valley courses. The groundwater level usually reaches its maximum level ranges from 3.5 to 5 m, whereas, reaches a maximum drawdown of 5 m below ground surface. The annual discharge rate is calculated as 212211m3/year, and the result indicates that the renewable storage capacity of the aquifer is very low compared to the annual needs 440920 m3/year.

Keywords: groundwater, assessment, bacteriological, hydrogen, sulphate.

1. Introduction:

Groundwater has always played, and continues to play a central role in human activities and water is a source of life and prosperity. The quality of water is as important as the quantity of water for the survival of human beings and many factors contribute to the determination of water quality for different usages (Diersing, 2009). For drinking water supply; the quality of water is controlled by the biological and chemical constituents contained in water in addition to the physical aspects of water (Stevens et al, 2001). In fact most of the health problems associated with poor quality drinking water in the developing world is related to the bacteriological aspects, since similar acute health problems and these disease-causing organisms (e.g. bacteria, viruses, protozoa, insects, etc.) are mostly water born, which are then transported by water to live in a human or animal host for growth and reproduction (Mark and Frederic, 2002).

2. Description of Study Area:

The study area (Abu Shouk and Al Salaam IDP camps) lie to the northeast of El Fasher town about 1.5 Km and separated by valley Haloof, and situated between latitudes 13^0 $39^/$ $42^{//}$ - 13^0 $29^/$ $41^{//}$ N and longitudes 25^0 $21^/$ $25^{//}$- 25^0 $57^/$ $27^{//}$E, and at an altitude approximately between 755 and 745 m above mean sea level. It is covers an area of approximately 6.3 km^2 (Fig, 1). According to the (Census, 2008) the population of the study area has been estimated to be 101000 inhabitants approximately. Surrounded by sand dunes, hills and mountains and most the surface area is covered by fixed and stabilized sandy plain soil and sand dunes, as well as low mudflats which resulted from the streams of valley Haloof (Tearfund's, 2007). Generally, the water resources are limited by two sources of water available to people in area, the first one these include; surface water and second is the groundwater which are extensively used (WES, 2016). It a typical phase of the desert and semi-desert zones (El Samani, 1987), the average annual rainfall ranges from 150 to 286 mm, and the average temperature is 20^0C and it rises up to 36^0C in the summer season (El Fasher Meteorological Station, 2017). Geologically, area is composed of Superficial deposits and Basement Complex (Gachet, 2006). The superficial deposits, produced by derivative from the basement complex and windblown sands forming undulating sand dunes of various thicknesses and generally include; valley alluvial and sand dunes (Hydro master, 2002), whereas, the outcropping of basement complex represents more than 70% of the surface area. (Arabi, 2005) stated that the basement complex rocks are the oldest rocks type in the study area and are considered to be of Pre Cambrian age, although some intrusive rocks may be younger. The rock units are comprised of two main groups: Metamorphosed group of banded gneisses, schist and low grade Meta sediment rocks and Post metamorphic group of igneous intrusions mainly granitic or syenitic in character and later group of minor intrusions in form of dykes, pegmatites and quartz veins (Fig, 2 and 3).

3. Methodology:

Several field trips to the study area were done to confirm the exact location of hand pumps and boreholes using Global Positioning System (GPS), and collect water samples (20 samples) for bacteriological analysis. The bacteriological analysis was taken by hydrogen sulfide (H_2S) test method, was used qualitatively as a presence/absence test with a water sample typically 20 ml. GIS technique was used to construct water sample location sites and Strater Demo-4 used for great cross-sections. Surfer-10 software used for constructs maps of contours water level, wells

Vol. 2, No. 02; 2017

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yield and the groundwater flow direction. Electronic Automatic Logger and water level indicators devices used for measured groundwater level.

4. Results and Discussions:

Determining the microbial quality of drinking water by measuring the presence, absence or concentrations of indicator bacteria continues to be widely practiced worldwide; to meet water quality standards and guidelines, to determine source water quality, treatment system efficacy and distribution system integrity, and to inform water safety plans, risk assessments and management systems.

4.1 Bacteriological analysis:

The water samples collected from twenty (20) hand pumps and boreholes, the bacterial tests made by using Hydrogen sulfide (H_2S), from Table, 1, all samples of water show that have negative results/no indication of contamination, and the groundwater in the area is good and excellent for domestic uses.

4.2 Groundwater Bearing Formation:

The groundwater bearing formation of the study area comprises mainly of the two major groups, these are the basement rocks (weathered and fractured) and alluvial deposits of valley courses. The average of water table ranges from 28.5 to 36 m, the depth of wells ranges from 37 to 63 m (Fig, 4), the yield ranges from 0.75 to 3 m^3/hfor hand pumps and from 3.5 to 9.5 m^3/h for motorized pumps, and 12 m^3/h in alluvial deposits, casing used PVC, the recharge direct from rainfall and from valley Haloof, and the groundwater flows southwest direction to joint valley El Ku alluvial system (Fig, 5).

4.3 Groundwater level fluctuation:

The measurements indicate that the groundwater level usually reaches its maximum level ranges from 3.5 to 5 m below ground surface between (September and October), whereas, reaches a maximum drawdown of 5 m below ground surface in (June), before the beginning of the rainy season (Fig, 6).

4.4 Wells yield:

About 24 hand pumps have been in use in Abu Shouk and 18 hand pump and berohles in Al Salaam. In Abu Shouk, the reported yields of boreholes fitted with hand pumps are generally in (0.75 - 1.5 m^3/h) (18 - 36 m^3/d) in average and (3.5 - 4.5 m^3/h) (81.6 - 108 m^3/d) in average for motorized pumps, while, in Al Salaam the reported yields of boreholes fitted with hand pumps are generally in (1.3 - 3 m^3/h) (31.2 - 72 m^3/d) and (9.5 m^3/h) (228 m^3/d) in average for motorized pumps, whereas, in alluvial aquifer the boreholes pumped only for three hours per day and producing about 12 m^3/h (180 m^3/d) (five wells) in average, and the total average of well yield estimated to be 581.4 m^3/d. According to Darfur IDPs Groundwater Resources Report (UNICEF, 2007), the consumption rate is 1208 m^3/d (440920 m^3/year), now the annual discharge rate is calculated as 581.4 m^3/d (212211m^3/year) in addition to the lost due to the groundwater seepage and evaporation. The result indicates that the renewable storage capacity of the aquifer is very low compared to the annual needs440920 m^3/year (Fig, 7).

5. Conclusion:

The main objective of the study is to assess the groundwater quality based on bacterial properties. The results show that, all samples of water have negative results/no indication of contamination and the groundwater in the area is good and excellent for domestic uses. The groundwater bearing formation comprises mainly of the basement rocks (weathered and fractured) and alluvial deposits of valley courses. The groundwater level usually reaches its maximum level ranges from 3.5 to 5 m, whereas, reaches a maximum drawdown of 5 m below ground surface. The annual discharge rate is calculated as 212211m^3/year, in addition to the lost due to the groundwater seepage and evaporation. The result indicates that the renewable storage capacity of the aquifer is very low compared to the annual needs 440920 m^3/year.

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Vol. 2, No. 02; 2017

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Table, 1: Result of Bacteriological analysis of samples in the Area

No.	Type of source	coordinates		Sample Date	Sample Result Date	Sample Volume ml	H_2S	Remark
		Lat.	Long.					
1	**H.P**	**1339481**	**2523410**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
2	**H.P**	**1339504**	**2520363**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
3	**H.P**	**1339401**	**2521108**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
4	**H.P**	**1339370**	**2520307**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
5	**H.P**	**1339473**	**2521211**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
6	**H.P**	**1339548**	**2521210**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
7	**H.P**	**1339578**	**2521291**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
8	**H.P**	**1340135**	**2521155**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
9	**H.P**	**13401**	**252115**	**1/8/201**	**3/8/2016**	**20**	+	**Free of**

Vol. 2, No. 02; 2017

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		45	**7**	**6**				**Contamination**
10	**H.P**	**1339593**	**2521240**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
11	**B.H**	**1323313**	**2556175**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
12	**B.H**	**1334533**	**2556351**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
13	**B.H**	**1339322**	**2552670**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
14	**B.H**	**1330316**	**2547461**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
15	**B.H**	**1330114**	**2557128**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
16	**H.P**	**1323519**	**2546116**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
17	**H.P**	**1324163**	**2555247**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
18	**H.P**	**1330990**	**2556090**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
19	**H.P**	**1328484**	**2543191**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**
20	**H.P**	**1327371**	**2550261**	**1/8/2016**	**3/8/2016**	**20**	+	**Free of Contamination**

Note: (+) Negative, i.e., no indication of contamination.

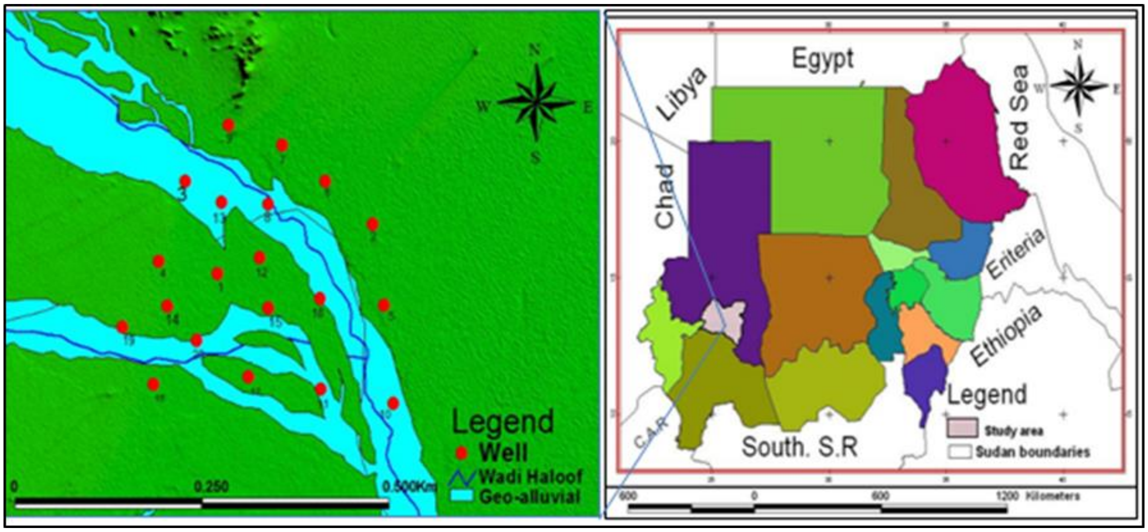

Fig (1): Site of water samples

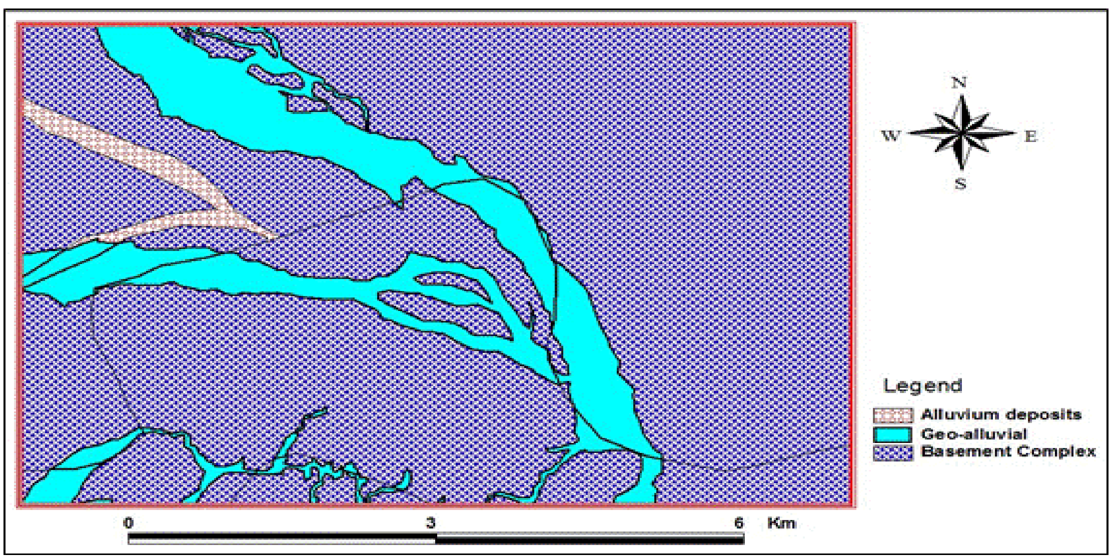

Fig (2): Geology of Study Area

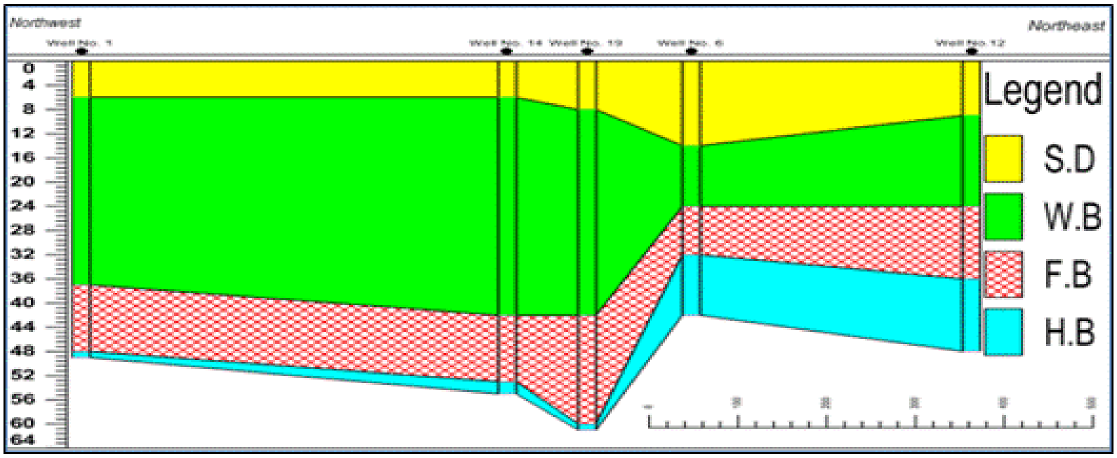

Fig (3): Cross section of Study Area. (Notes: S.D; superficial Deposits, W.B; Weathered Basement, F.B; Fractured Basement, H.B; Hard Basement Complex).

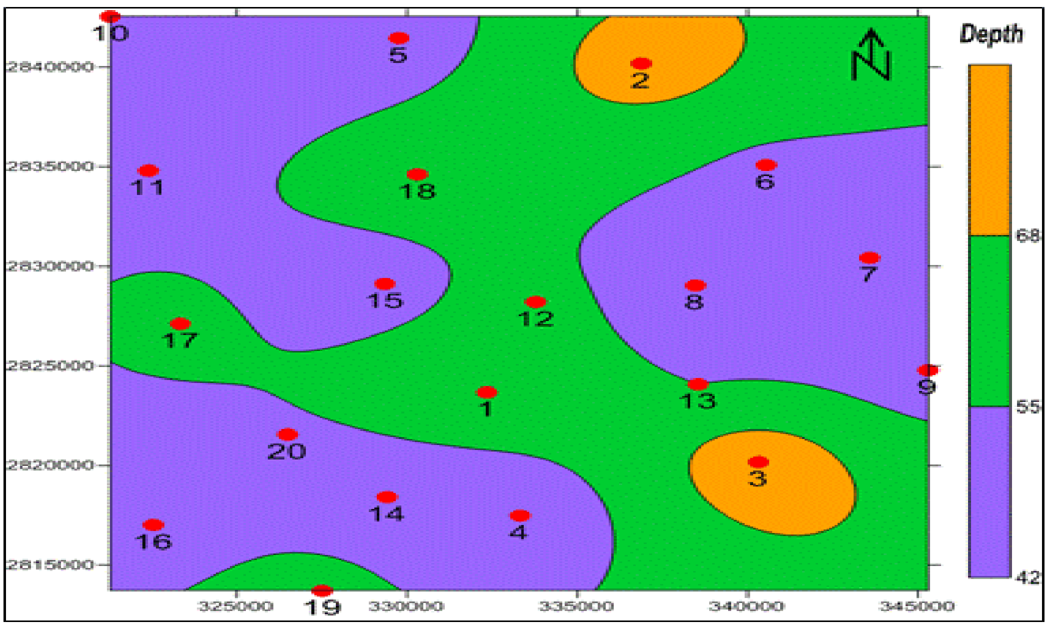

Fig (4): Spatial distribution of well depth in the area

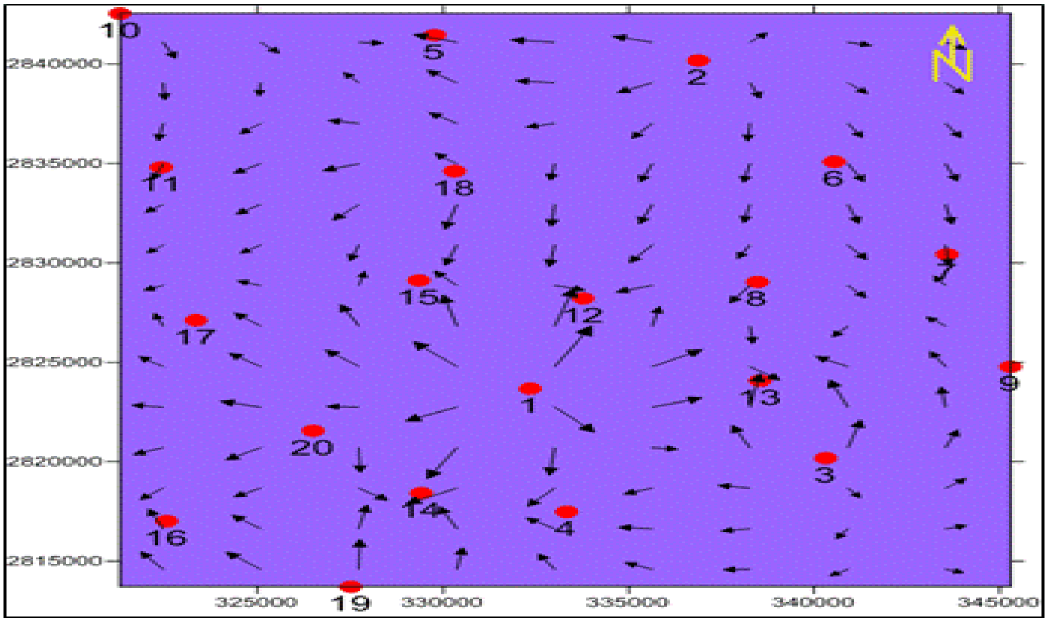

Fig (5): Groundwater direction flow

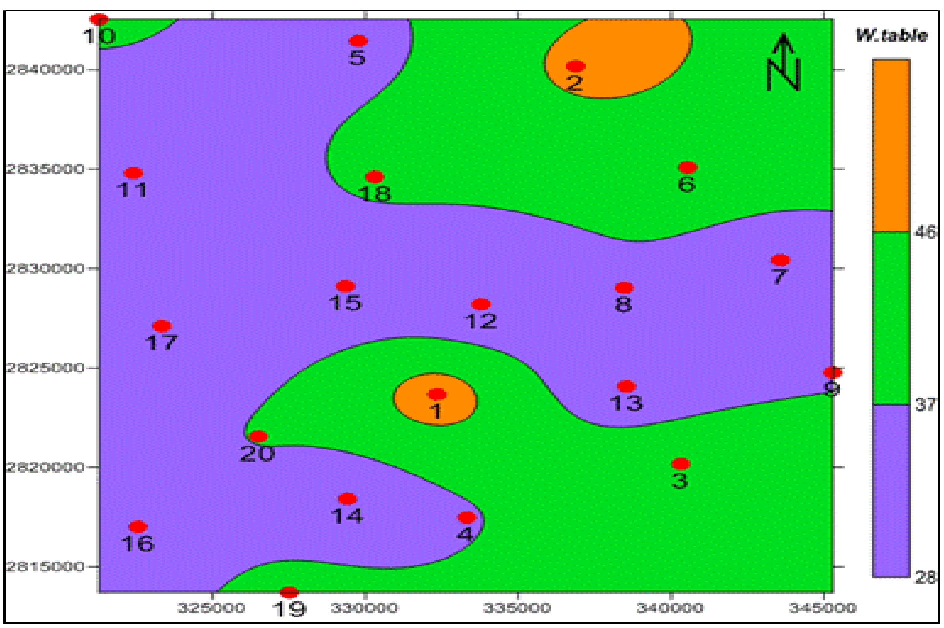

Fig (6): Spatial distribution of groundwater level in the area

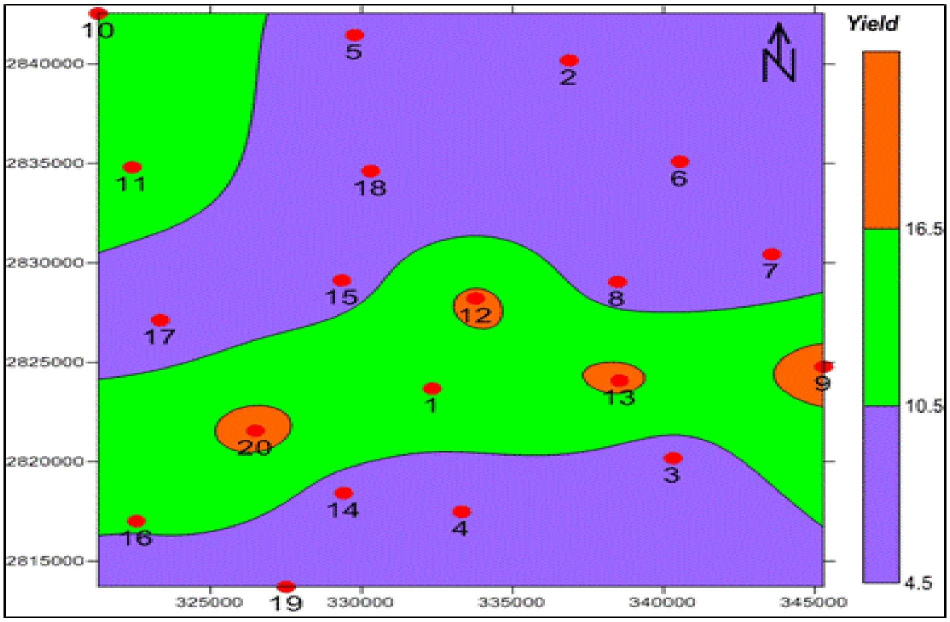

Fig (7): Spatial distribution of well yield in the area