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Assessment of Nitrate Content in the Cultivated and Uncultivated Soils in the Western Part of Jifarah Plain area, Libya.

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ABSTRACT: *The population in Jifarah plain area depend on its land resource for the human consumption. This resource is subject to the pollution from the agricultural activities. No studies have been carried out to assess the levels of nitrate in the soils of the study area. The objective of the current study was to measure the nitrate levels in the cultivated and uncultivated soils. Forty soil samples were collected at a depth of ranged from zero (0) to 40 cm and analyzed* for *nitrate (NO_3), electrical conductivity (EC), pH, and Fluoride (F). According to the results obtained from this study, the concentration of nitrate in the cultivated soils found between 8.62 – 70.75mg/ kg soil with an average of 18.20mg/kg soil. Whereas, its level in the uncultivated soils was in the range of 5.75 and 32.56 mg/kg soil with an average of 13.88mg/kg soil. This study revealed that the nitrate levels in the cultivated soils were higher than the levels in the uncultivated soils that is indication of excessive amounts of the chemical fertilizers. It also revealed that 5 % (2 samples) and 10 % (4 samples of the cultivated and the uncultivated soils respectively crossed the limit of 10 – 50 mg / kg in soil recommended by the State of Queenland, department of employment, economic development and innovation, Australia. we recommend that the soils can be used for crop production. We also recommend that frequent analysis should be conducted to monitor the levels of nitrate in the soils and ground water.*
Key words:- *Nitrate, Soils, Cultivated, Uncultivated, Jifarah plain, Libya*

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I. INTRODUCTION

Most of nitrogen of the earth (> 98 %) is found in the lithosphere, either in crust of the earth, in igneous and sedimentary rocks, oceanic sediments or in soils. Hydrosphere and biosphere contain 2% nitrogen. In the atmosphere, nitrogen is found mainly as the inert gas, which comprises 78 % of its volume. In the hydrosphere, nitrogen occurs in dissolved forms, some of which are organic, but more commonly in simple inorganic forms. In the biosphere that consists of living plants and animals, it occurs mainly in in organic forms that are often complex, but also in simple inorganic forms. The content of most soils and ranges between 200 and 4000mg/kg with an average of 1400 mg / kg soil [1]. Nitrogen is the most important element for plant nutrition, and it can become available form for plant uptake. Application of nitrogen fertilizers is essential to increase the crop yields [2]. Nitrate pollution has drawn worldwide attention due to the detrimental aspects of its excess in the natural resources such as, soil and water. Changes in the soil properties due to the agricultural practices and their consequences for crop production have been a concern of research for decades. According to [3] Nitrate levels in soils should not cross the limit of 10 – 50 mg/kg soil.

Several earlier studies have examined the effect of the agricultural activities such as cultivation and fertilization, on the chemical properties of the soils [4 – 7]. It was shown that chemical fertilizers have contributed significant amounts of nitrogen that they contain [8]. [9] Found that in the soils of temperate areas the levels of the total nitrogen to a depth 15cm ranged from 0.08 % in the cultivated sand soils to 0.5 % in clay soils under long-term grassland, and that nitrogen content decreased with increasing the depth. He reported that the total nitrogen to a depth of 40 cm was between 5000 and 15.000 kg / ha in long-term grassland soils, and between 2000 and 4000 kg / ha in the cultivated soils.

Whereas, [10] indicated that high nitrate levels in the soils are attributed with the agricultural activities.[11] carried out a study to assess the nitrate concentrations in the cultivated and in the uncultivated zones and found that the levels of nitrate from the cultivated zone was five times higher than that of nitrate from

uncultivated zone. [12] Reported that the accumulation of nitrate in the soil profile has negative effect on ground water quality. [13] Studied nitrate concentrations in the cultivated and non – cultivated soils and reported that the nitrate levels in the cultivated soils were higher than the levels in the non – cultivated ones and that due to the excessive amounts of chemical fertilizers, which applied to the cultivated soils. [14] Reported that the concentrations of nitrate in the clay soils were higher after cultivation. [15] Studied the effect of cultivation on the physical and chemical properties of a vertisols in Ethiopia and found that the cultivation has significant influence. [16] Reported that the excessive Nitrate levels in the soils is due to the nitrogen over fertilization.
[17] Conducted a study to compare the soil properties in cultivated and uncultivated soils and reported that the properties were influenced by cultivation. The agricultural practices such as, land use changes some soil physical and chemical properties [18]. [19] Reported that the chemical properties are different in the cultivated and uncultivated soils.

[20] Investigated the levels of nitrate in some soils and reported that the nitrate levels were higher in the sample areas than their levels in the control samples and that is due to excessive a mounts of fertilizers applied to the soil. [21]. indicated that the high levels of nitrate in ground water is associated with the intensive cultivation.

The concentrations of nitrate in the agricultural soils increased by fertilization [22]. Pabalinga [23] reported that the heavy irrigation periods and the excessive amounts of chemical fertilizers are resulting in leaching of nitrate from the soil profile.[24] Carried out a study to investigate the levels of nitrate in the cultivated and uncultivated soils and reported that the both soils had the similar levels of nitrate. Whereas, the cultivated and irrigated subsoil had a higher content of nitrate than the uncultivated soil.

However, there are some indications that nitrate in ground water was assessed in the study area. There are no research papers indicating the levels of soil nitrate in Jifarah plain area. Therefore, this study was carried out to assess the nitrate levels in the cultivated, uncultivated soils and to build a database for future researches.

II. METHODOLOGY

Jifarah plain area located between latitude 32° 30` and longitude 12° 30`, Northwest of Libya. It cover an area of 20000km2 and heavily populated along the coast. The area bounded on the north by the Mediterranean Sea coast; on the south by Nafusah, mountain .It also shares an international boundary with Tunisia to the west (Fig 1). The area topographically is a low lying; its topography rises slowly from the sea level along the coast to 200 m at the foot of the escarpment of Nafusah Mountains. The maximum temperature is about 45°C and minimum 20°Cwith an average annual rainfall varies between 300 and 100mm. It has a dry climate with hot summer and cold winter. Groundwater considered the main source of water supply in the area. The dominant soils are sandy, clay and salty soils. Economically, Jifarah plain is considered one of the most important plains in Libya, the described area is known as an urban and rural area that the society mostly depends on its land resource for the human consumption. A round 60% of the irrigated areas situated in this region. The agriculture considered one of the most important activities in the area where barley, wheat, peanuts, vegetables and fodder crops are grown.

No studies have been done in the Jifarah plain area, the current study were carried out to assess the concentration of nitrate in the soils and to build a database for the levels of nitrate in the soils in the study area. In the current study, 40 soil samples were collected from cultivated and uncultivated soils using Global-positing system (GPS). The samples were taken within a depth range of 0 to 40 cm in January 2018 at the selected sites from the western part of Jifarah plain area, Libya (Fig 1). The surface of each soil-sampled hole examined carefully to ensure that no stocks and remains of plants were present. The samples were collected with digging vertically and were kept in labeled clean polyethylene plastic bags and brought to the laboratories of nuclear research center, Tajoura, Libya. Analysis such as nitrate (NO3), electrical conductivity (EC), Fluoride (F), and pH were performed using standard procedures (Table 1). The concentrations of nitrate and fluoride expressed in terms of mg / kg soil DW. Whereas electrical conductivity was in (µs / cm) and the graphs were created using Sigma plot software

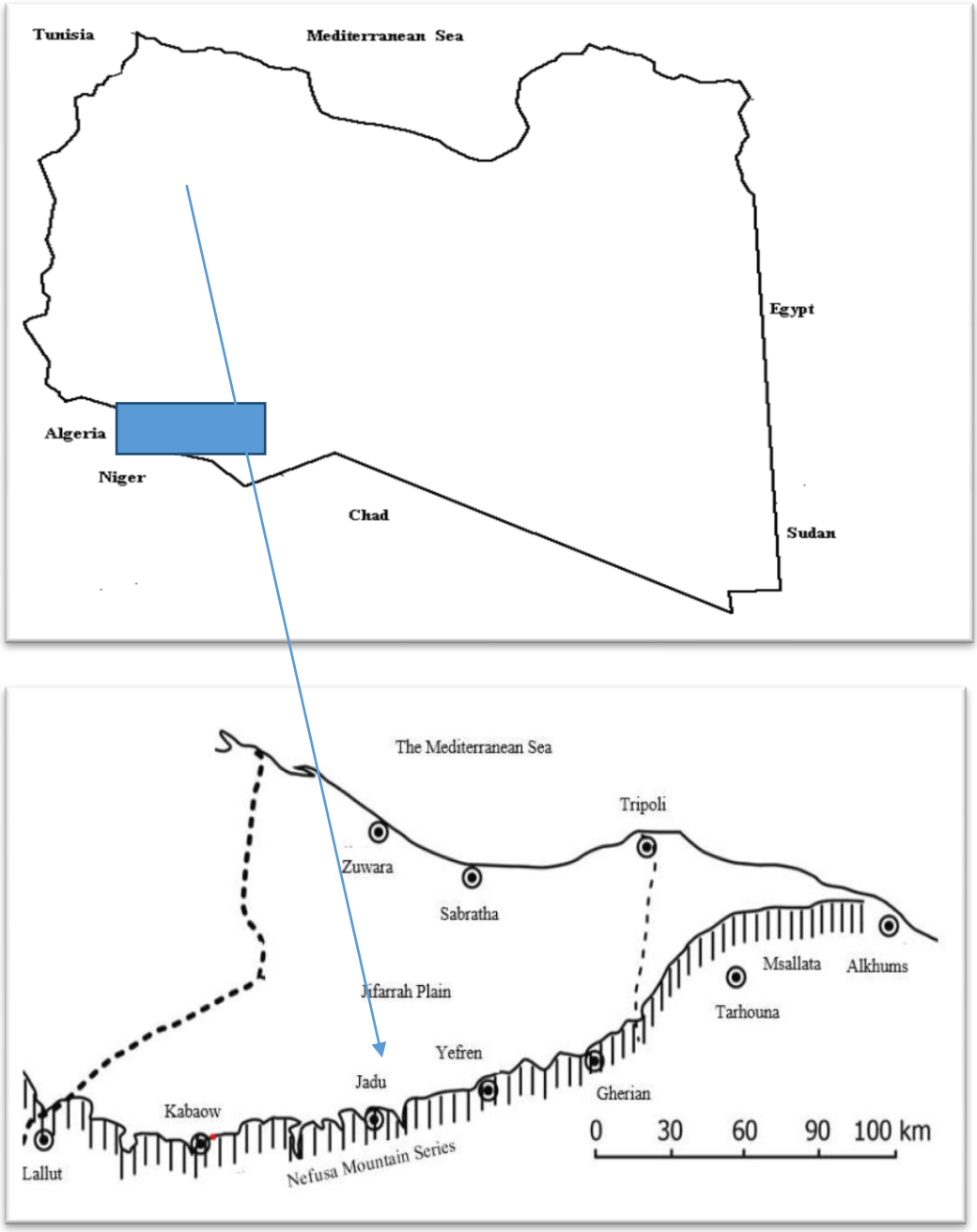

Fig. 1. Map of Libya showing the study area.

S.N	Parameter	Test method	Instrument
1	Nitrate (NO3)	1:2 ratio, 2MKCl	UV-Vis Spectrophotometer
2	Fluoride (F)	(Alizarin Red Zirconyl Chloride) (1:10) ratio, air saturated water	UV-Vis Spectrophotometer
3	Electrical conductivity(EC)	(1:2) extract solution	WTW730
4	pH	(1: 2) extract, measured at Phases contact	Toledo MP 220

Table 1: Methods and instruments used to analyze the parameters

III. RESULTS AND DUSSCUTION

Nitrate concentrations of cultivated and uncultivated soils in forty sites of Jifarah plain area, Libya are illustrated in Fig 2. The levels of Nitrate in the cultivated soil samples varied from 8.62 – 70.75 mg / kg soil DW with an average of 18.20 mg / kg soil DW. The lowest value was measured in site numbered 14 whereas; the highest level was noticed in site numbered 9. The high concentrations in the cultivated soils suggest that nitrogen fertilizers have been applied to the soils.

Nitrate amounts in the uncultivated soils were found between 5.75 and 32.56 mg/kg soil DW with an average of 13.88 mg/kg soil DW. The maximum value was measured in site numbered 9 and the minimum one was recorded in site numbered 14. The results of the current study were in agreement with [14, 17]. The results revealed that pH values in the cultivated soils varied from 8.03 to 9.1. The lowest pH value was noticed in site numbered 6 while the highest was seen in site 1. pH values in the uncultivated soils ranged between 8.14 and 9.23 with an average of 8.72. The minimum value was observed in site numbered 2 and the maximum was noticed in site 15 (Fig 3).

The electrical conductivity (EC) in the cultivated soils was in the ranged of 82.5 and 2840 Microsimens / cm with an average of 569.07. The lowest and the highest values were measured in sites 13 and 4 respectively. Whereas, the electrical conductivity values in the samples collected from uncultivated soils was found between 95 and 1710 with a mean value of 244.48. The lowest value of EC was noticed in site numbered 3 and the highest one in site 5 (Fig 4). Fluoride levels of the cultivated and the uncultivated soils were displayed in fig 5. The fluoride levels in the cultivated soils varied from 0.03 to 41.05 mg / kg soil with an average of 9.61 mg / kg soil. The lowest value were observed in the sites numbered 2,4,6,7 and 16 whereas, the highest level was measured in site numbered 1. On the other hand, the fluoride content in the uncultivated soils was found between 0.03 and 29.39 mg / kg soil with an average of 7.42 mg /kg soil. The minimum limit was recorded in the sites 4,5,15 and 16 and the highest one was measured in site numbered 10

As can be seen from the results displayed in figs 4 & 5 the most values of the electrical conductivity and the fluoride in the samples collected from cultivated sites were higher than the levels in the uncultivated soils and that is probably due to the fertilizer application for a long period. There is weak negative coefficient correlation of nitrate concentrations with electrical conductivity in the samples collected from cultivated and uncultivated soils (r = - 0.062 and r = -0.329) respectively. Whereas, pH values had weak positive coefficient correlation with nitrate concentrations in the samples collected from cultivated soils (r = 0.103) and uncultivated soils (r =0.021). The correlation coefficient between fluoride and nitrate was very poor in the both soils

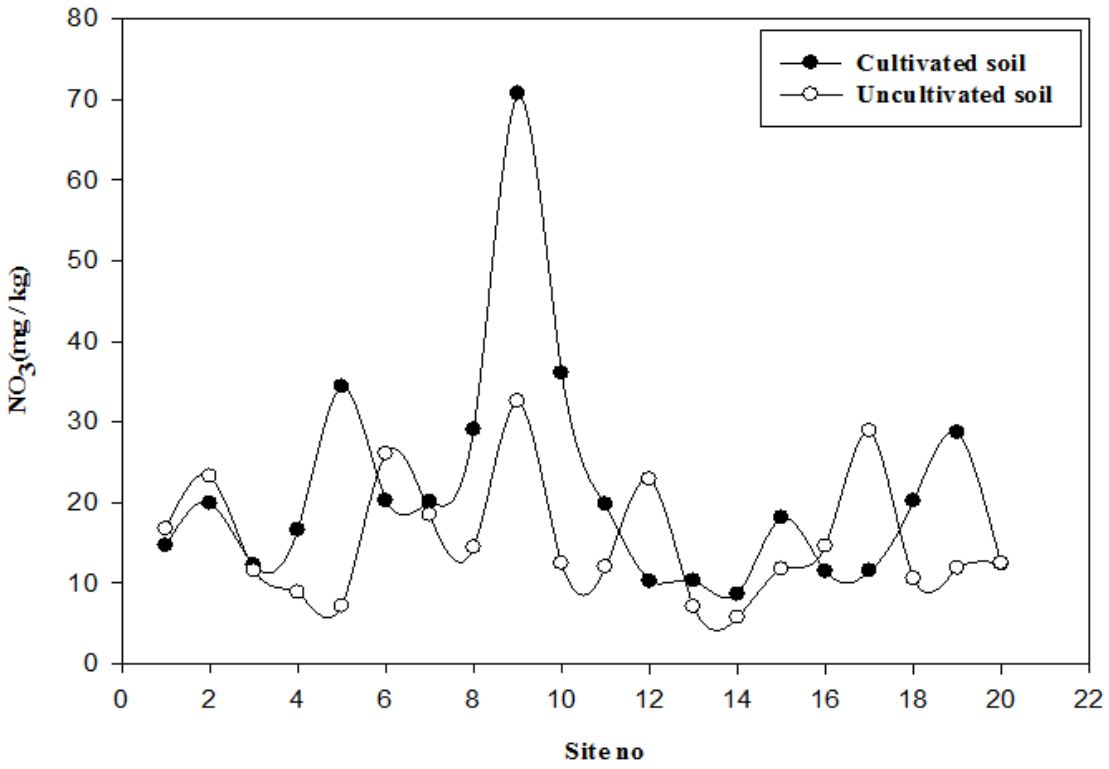

Fig. 2 . Concentrtaion of nitrate in the study area

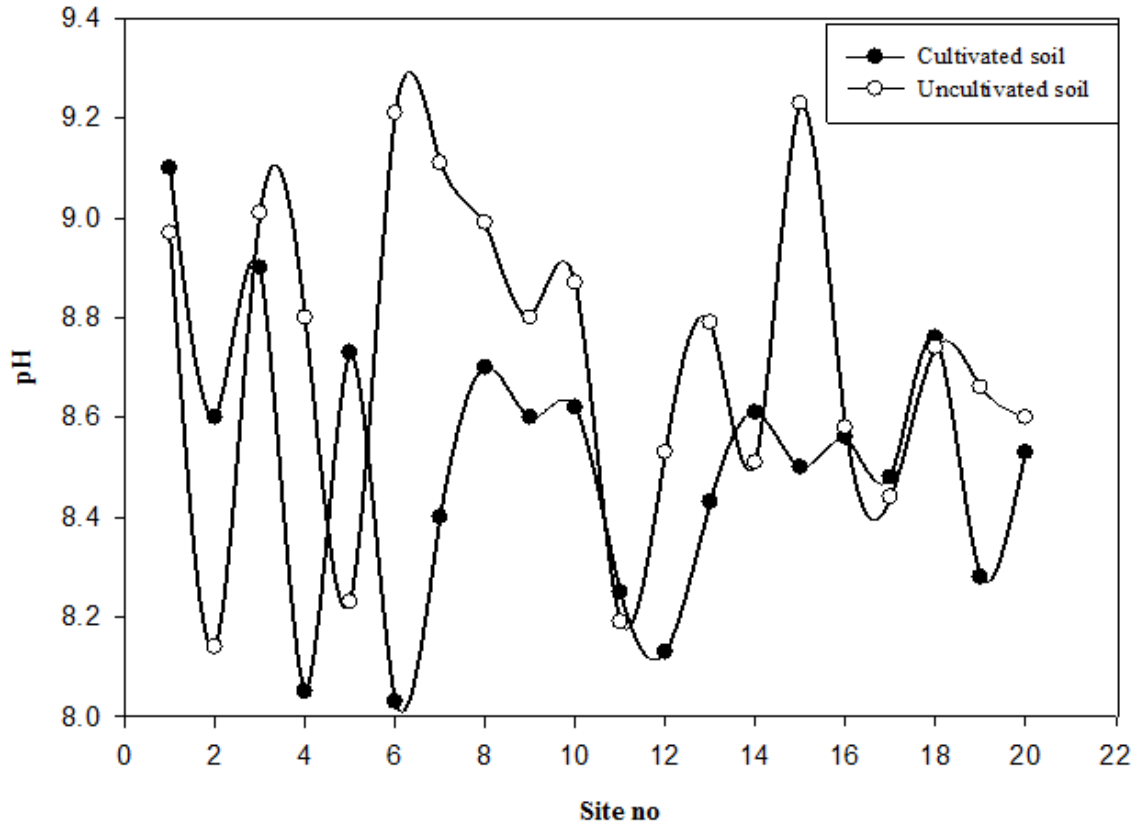

Fig. 3. Levels of pH in the study area

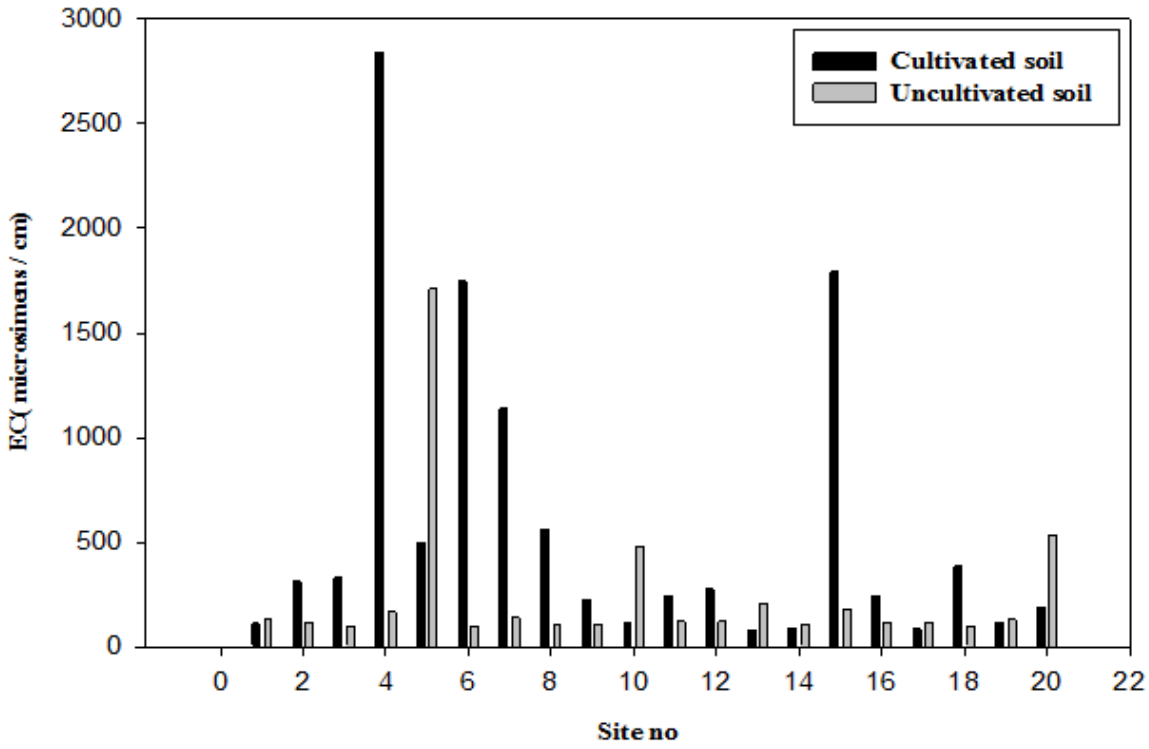

Fig. 4. Concentrations of the electrical conductivity in the study area

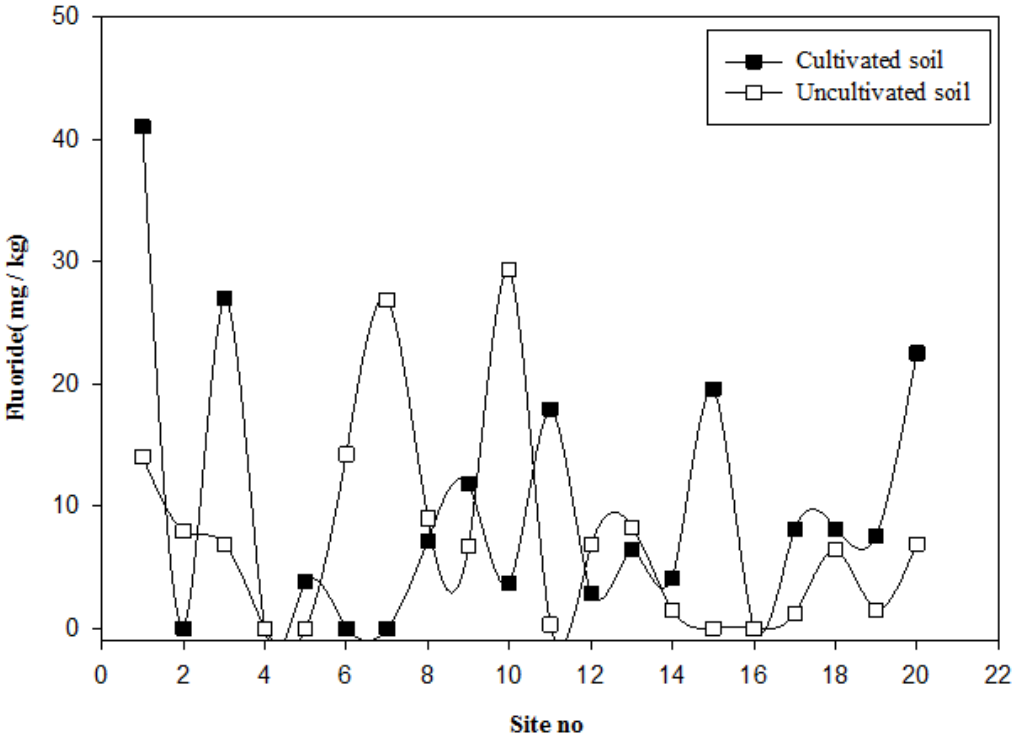

Fig. 5. Concentrations of fluoride in the study area

V. CONCLUSION AND RECOMMENDATIONS I

On the bases of the current study, it can be concluded that nitrate concentrations investigated in the most of the soil samples collected from cultivated and uncultivated soils were below the limit (10 – 40 mg/kg soil recommended by the State of Queenland, department of employment, economic development and innovation, Australia. It also can be concluded that the agricultural practices such as, cultivation and nitrogen fertilizers have no serious deleterious effect on the soils in the study area. Therefore, we recommend that the soils can be used for crop production. We also recommend that frequent analysis should be carried out to monitor the levels of nitrate in the soils and ground water.

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REFERENCES

[1]. Lindsay, W. L, Chemical equilibrium in soils. Wiley – Interscience, New York, USA, and PP: 282 – 298, (1979)
[2]. Edmeades, D.C, The long – term effect of manures and fertilizers on soil productivity and Quality: a review. Nutr.Cycl. Ageoecosyst. 66: 165 – 180, (2003).
[3]. Bagshaw, J., Moody, P., and pattison T., Soil health for vegetable production in Australia part 4 measuring soil health. The State Of Queeland, Department of employment, Economic development and Innovation (2010)
[4]. Puhr, L.F., Olsen, O, A preliminary study of the effect of cultivation on certain chemica And physical properties of some South Dakota soils, AES Bull. 214, South Dakota College, Brookings, SD, P. 314 (1937)
[5]. Jenny, H, the Soil Resources. Springer – Verlag, New York, New York (1980)
[6]. Miller, R. W., Gardiner, D. T, Soils in Our Environment, 8th ed. Prentice – Hall, Upper Saddle River, NJ 07485 (1998)
[7]. Brady, N. C., Weil, R.R, the Nature and Properties of Soils, 13th ed. Prentice – Hall, Upper Saddle River, NJ 07458 (2002)
[8]. Clark, F, E. and Woodmansee, R. G, Nutrient cycling. In: Whitehead, D.C. (ed) Nutrient Elements in Grassland: Soil – plant-animal Relationship, CABI Wallingford (1992)
[9]. Archer, F.C, nutrition and fertilizer use In: Whitehead, D.C. (Ed) Nutrient Elements in Grassland: Soil – plant- animal Relationship, CABI Wallingford (1992)
[10]. Mehmet Ali Kurt, Cuheyt Guler, Musa Alpaslan and can Akbulut, Determination of Nitrate and nitrite origins in the soils and ground waters of the area between Mersin – Tarsus (Turkey) using geographic information systems. Carpathian Journal of earth and environmental Sciences, vol.7, No. 4, p. 181 – 188, (2012).
[11]. Jose Miguel Sanchez pere Z, Inaki Antiguedad, Inaki Arrate, Cristina – Garcia – Linares, Ignacio Morell, The influence of nitrate leaching through unsaturated soil on ground water pollution in An agricultural area of the Basque County: a case study. Science of the total Environment, vol.317, pp.173 – 187, (2003).
[12]. Jun Fan, Mingde Hao, and S.S. Malhi, Accumulation of nitrate – N in the soil profile and its Implications for the environment under dryland agriculture in northern China: A review. Canadian Journal of soil science (2010).

[13]. D.D. Maio, T.E. Schumacher, J.J. Doolittle, Long – term cultivation impacts on selected soil properties in the northern great plains. Soil and Tillage Research, 81, 277 –n291, (200).
[14]. R.J.Dowdell and R.O. Connell, Effect of plowing and direct drilling on soil nitrate content. Journal of soil science, vol. 26, No.1, (1975).
[15]. T. Girma, Effect of cultivation on physical and chemical properties of a vertisol in middle Awash valley, Ethiopia, Communication in soil science and plant analysis,29: 5 – 6, 587 – 598, (1998).
[16]. Tarek G. Ammari, Impact of agricultural practices on soil nitrate accumulation in the Jordan Valley: The urgent need for soil nitrogen management planning, world applied Sciences Journal, 15 (12): 1746 – 1751, (2011).
[17]. Crisanta S. Bueno. J.K. Ladha, Comparison of soil properties between continuously cultivated And adjacent uncultivated soils in rice – based systems. Biol Fertil Soils, 45, 499 – 509, (2009).
[18]. Paz- Gonzalez A, Vieira SR, Taboada Castro MT. The effect of cultivation on the spatial variability Of selected properties of an umbric horizon. Geoderma 97:273–292, (2000).
[19]. A.N.Ganeshamurthy, Soil changes following long – term cultivation of pulses. Journal of Agricultural science, 147, 699 – 706, (2009).
[20]. E.I.uwah,J. Abah, N. P. Ndahi and V.O. Ogug buaja, Concentration levels of nitrate and nitrite In soils and some leafy vegetables obtained in Maiduguri, Nigeria, Journal of applied science In environmental sanitation, volume 4, N3: 233 – 244, (2009).
[21]. Manik Chandra Kundu & Biswapati Mandal, Agricultural activities influence nitrate and fluoride Contamination in drinking ground water on an intensively cultivated District in India. Water, air,Soil pollut, 198: 243 – 252, (2009).
[22]. Z .Nesic, Z. Tomic, V. Krujaja, D. Tomasevic, Nitrates in plants and soil after fertilization of Grass – Legume mixtures. Biotechnology in animal husbandry, 24 (5 – 6), P 95 – 104, (2008).
[23]. Pabalinga, N., Mubyana - John,T., Pule – Meulenberg, F. and Mpuisang, T., Soil nitrate and nitrite in Different soil properties of Peri – Urban and horticultural farm soils of Gaborone as indicators of Nitrogen leaching. Fourth Reform Biennial regional Conference 21 – 25 July 2014, Maputo, Mozambique.
[24]. Andrea Vushe, L Offievon Landsberg, Alexander Groengroeft and Damas A. Mashauri, Nitrate leaching in irrigated inorganic agriculture: A case study of Mashare commercial farm In Namibia, Okavango River Basin. African Journal of Agricultural research vol. 11 (31), pp 2871 – 2881, 4 August, (2016).