CASE STUDY

3(11), July - September, 2017

ISSN 2394–8558
EISSN 2394–8566

Climate Change

Evaluation of the effects of reclaimed urban wastewater on soil calcium carbonate concentration case study: Yazd waste water refinery

Azam Abolhasanizarjoo[1], Hasan Khosravi[2], Mehdi Soltani Gerd-e faramarzi[3]

1.M.Sc. Expert, Natural Resources Engineering - Living with the desert – University of Tehran, Iran, Email: azamabolhasani67@yahoo.com
2.Faculty member of Natural Resources, University of Tehran, Iran, Email: hakhosravi@alumni.ut.ac.ir
3.M.Sc. Natural Resources and Agriculture Research Center of Yazd Province, Iran, Email: m_soltani50@yahoo.com

Publication History
Received: 26 April 2017
Accepted: 04 June 2017
Published: July-September 2017

Citation
Azam Abolhasanizarjoo, Hasan Khosravi, Mehdi Soltani Gerd-e faramarzi. Evaluation of the effects of reclaimed urban wastewater on soil calcium carbonate concentration case study: Yazd waste water refinery. *Climate Change*, 2017, 3(11), 792-796

ABSTRACT

Water crisis is an important issue in arid and semi-arid regions like Iran. This situation has been exacerbated in recent years because of successive droughts. So the use of unconventional water is increasing in where there is no water with good quality. One of these resources is urban wastewater that can provide nutrient for plant in addition to supplying water. If municipal wastewater does not led to negative impact on physical and chemical properties of soil and water; it can be used for irrigation in de desertification projects. So in this research the effect of reclaimed urban wastewater on soil Calcium Carbonate concentration was assessed in Yazd wastewater refinery. For this purpose, soil samples were collected from depths of 0-30 cm and 30-60 cm in three different regions

consist of control area, planting area that was irrigated with reclaimed urban wastewater and region that had no plant but was influenced by treated wastewater. Samples were dried and then transported to the laboratory and Calcium Carbonate concentration was evaluated in all of them and then the results were analyzed using SPSS software. Results showed that the amount of Calcium Carbonate has decreased in planting area that was irrigated with treated wastewater and it has increased in region with no plant that was affected by treated wastewater.

Keywords: Unconventional water, Irrigation, Water crisis, Reclaimed wastewater, Calcium Carbonate.

1. INTRODUCTION

The population growth rate is estimated to average about 7.1 percent [12]. According to estimates, every year 100 million people, or in other words per second more than three people added to the world population. According to the forecast, in 2025 the world's population of 8.5 billion will go beyond border. Meet the needs of a growing population; the food can be considered a major problem for many nations [2]. In developing countries the increasing need for fresh water in agriculture production is not limited to, but needs per person and also supplies the needed water resources industry needs and priorities of the urban communities in these areas [10]. Existence large population centers and industrial centers in the vicinity of fresh water resources according to the prioritization of municipal and industrial water supply, the share of agriculture in reduced access to these resources [1]. These factors have led to the idea of planning to provide new sources of water. This idea that purification of domestic and industrial wastewater should led to production of recycled water with high quality that can be reused for different projects, has been strong in late twentieth century. This idea has created the motivation of the use of treated wastewater in many parts of the world [4]. Using wastewater for irrigation can be a proper alternative for water with good quality and also can reduce plant requirement to fertilizer [3]. In fact the reuse of wastewater for irrigation is increasingly being considered as a technical solution to minimize soil degradation and to restore nutrient contents of soils [9]. Also the reuse of treated domestic wastewater in agriculture purposes has been increasingly considered to be beneficial for crop production [12, 14].The impact of wastewater on physical and chemical properties of soil is so important because of its impact on plant establishment and soil erosion and if it doesn't led to negative effect onphysical and chemical properties of soil and water; it can be used for irrigation. Many researches have been done about irrigation with wastewater around the world.

Rana Hassan Ali has evaluated the effect of treated wastewater on soil chemical properties and crop productivity in Gaza strip and showed that irrigation with wastewater led to significant increase in OM, CEC, K, Ca, Mg, Na and Cl in soil and also the increase of Zn, Fe, Mn and Pb in soil and sorghum plant compared to fresh water [7]. Emam Qoli study showed that irrigation of Haloxylonpersicum and Nitrariaschoberi with urban wastewater in Segzi plain of Isfahan has caused the increase of canopy cover and decrease of richness, also because of irrigation with wastewater the amount of EC, Na, total Ca and Mg and K has been decreased and the amount of N and Phosphor has been increased compared to control area [6]. Qishlaqi et al assessed the impact of untreated wastewater irrigation on soil and crops Shiraz suburban area; they believe that increase of pH, OM and Ca happened because of irrigation with untreated wastewater [16]. Salehi et al evaluated the effect of irrigation with urban wastewater on soil and pine trees in Tehran and showed that concentration of nutrients such as N, K, Ca, Mg and Ph has been increased in soil irrigated with wastewater [18]. Hoda A.A. Galal showed that long-term application of mixed wastewater for irrigation induced significant increase of soil pH and Ec, particularly in surface layer. She also indicated that mixed wastewater resulted in accumulation of K, Fe, Mn, Cu, Zn, Ni and Na in soil [8]. Elena et al evaluated the effects of wastewater irrigation on soil properties and indicated that there were no negative effects with respect to changes in soil pH but a significant increase in electrical conductivity and sodium content was observed in wastewater-irrigated soil [5].

As a regard, the majority of freshwater resources, is assigned to drinking, health and industry and a large amount of wastewater is produced, the reuse of reclaimed urban wastewater for different goals is an effective solution for compensation of lack of water resources. The main purpose of this study was evaluation of the effect of reclaimed urban wastewater on soil Calcium Carbonate concentration.

2. MATERIALS AND METHODS

2.1. Study area

Yazd is one of the provinces with the lowest precipitation in Iran, since the average of annual precipitation is only 61.02 mm [15]. Temperature diurnal and seasonal fluctuations are very high. The maximum temperature of Yazd province has been recorded in July about 45 °C and the minimum temperature has been recorded in January about -20 °C [15]. Low amount of precipitation, high temperature, high evaporation rate, successive drought and deep ground water level are the most important issues of Yazd province

[17]. Wastewater refinery of Yazd is located in 31°54′ north latitude and 54°24′ east longitude in north of Yazd city and its height is 1145 meters above sea level.

2.2. Methodology

Soil sampling:

Soil samples were taken from depths of 0-30 cm and 30-60 cm [19] in three different regions including control area, planting area that was irrigated with reclaimed urban wastewater and region that had no plant but was influenced by treated wastewater. Samples were dried and then transported to the laboratory for analyzing. Samples were collected by auger.

Laboratory section:

Lime index indicates the absence or presence of carbonates in soil. About 1% to 3% of it is tolerable for most of plants and more than this amount may damage plants. A large number of minerals, including K, Fe, Zn, Co and Phosphor are absorbed so slowly in calcareous soil. In Iran, absorption of trace element in soil is so difficult because of calcium ion presence. The amount of Organic Matter is low in this kind of soil; in fact, one of this soil disadvantages is lack of OM and humus. By adding Organic Matter to this soil, we can prevent Calcium Carbonate harmful effect.

In this research, Calcium Carbonate concentration was assessed using calcimeter method. This method is an accurate method that is used in different researches and is based on following equation:

$$CaCo_3 + 2HCL \longrightarrow CaCo_3 + Co_2 + H_2O$$

$$\% CaCo_3 = (0.15/ 36) \times (\text{Volume of emitted Co2/ Soil sample weight})$$

In fact, in this method the volume of emitted Co_2 is measured and then $CaCo_3$ concentration is counted.

Statistical analysis:

Statistical analysis of data was done using SPSS software, after determining the amount of Calcium Carbonate in samples. First, data normalization test (Kolmogorov-Smirnov) was done then data were analyzed using Duncan test in format of factorial design.

3. RESULTS AND DISCUSSION

Results:

The results showed that the amount of Calcium Carbonate has decreased in planting region that was irrigated with treated wastewater and it has increased in region with no plant that was affected by treated wastewater (table.1). Also the result indicated that land use and depth factors had a significant effect on Calcium Carbonate concentration in soil but the interaction between them had no significant effect (table.2, figure.1).

Table 1

Mean and Standard Deviation of Calcium Carbonate in study area

Region	depth	Mean	Std. Deviation	N
Planted region (wastewater irrigation region)	Surface layer	21/49	1/044	12
	deep layer	22/39	1/206	12
	total	21/94	1/196	24
No-planted region, influenced by wastewater	Surface layer	24/07	0/210	4
	deep layer	24/06	0/398	4
	total	24/06	0/294	8
Control region	Surface layer	22/81	0/524	4

deep layer	24/27	0/205	4
total	23/54	0/865	8

Table 2 Effect of irrigation with reclaimed urban wastewater on soil Calcium Carbonate

Resource	df	F	Sig
Land use	2	19/731	0/000
Depth	1	5/515	0/025
Land use*depth	2	1/279	0/291

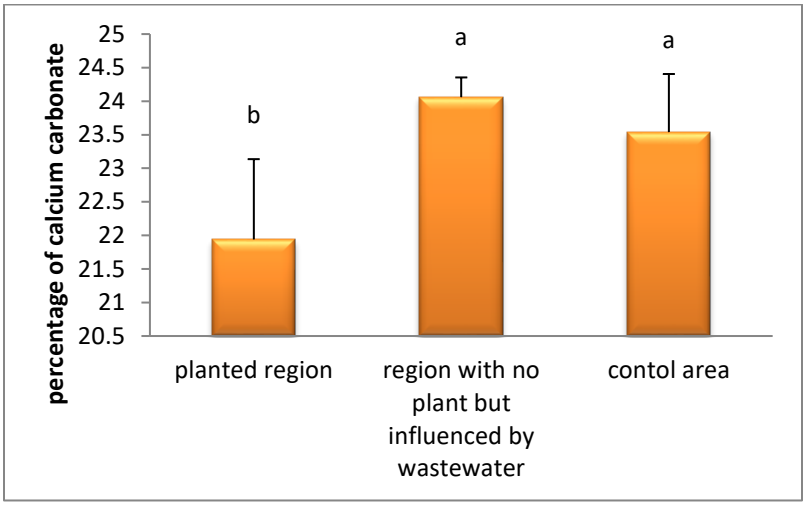

Figure 1
Changes of Calcium Carbonate in regions influenced by reclaimed urban wastewater compared to control area

Discussion:

Most soils of central plateau of Iran are alkaline soil and their pH is more than 7 because of Calcium Carbonate, Calcium Sulfate and salinity in soil. These soils are so poor in Organic Matter and one of their disadvantages is lack of humus and Organic Matter. Lime causes proper structure in soil but if the amount of it exceed, it can cause problems for plants by creating hard pan, high pH and salinity in root zoon [11].

In this study the amount of Calcium Carbonate has been decreased in planting region that was irrigated with treated wastewater and it has been increased in region with no plant that was affected by treated wastewater.

In general, using wastewater for irrigation or other activities should be done with careful planning and management and long-term conservation of resources should be considered in addition to protection of public health. On the other hand, under certain condition, use of this type of water if not well managed, can have negative impacts on cultivated crops and soils, so that the effluent for reuse must comply with reuse standard to minimize environmental and health risks [20].

REFERENCE

1. Abedi, D. C, and Najafi, C, 2001, Use of treated wastewater in agriculture, published by the national committee on irrigation and drainage, 47. 58-78.
2. Aggelide, S. M, and Londra, P. A. 2000, Effect of compost produced from town wastes and sewage sludge on the physical properties of a loamy and a clay soil, Journal of Bioresource Technology., 71, 253-259.
3. AlinezhadJahromi, Hadi, Mohammadkhani, Salehi, 2012, Effect of urban wastewater on growth, yield and

accumulation of Pb and Cd in a kind of medicinal plant, Journal of soil and water sciences, Volume 16, No 60.

4. Asqarzadehghochani, Bhezad,. Hossein Misami, saeidehsaeidi, Maryam Rezae, Amir Abdollahian, 2009, Recycled Water Management in the world, Simorq publishing of Khorasan.
5. Elena Castro, Maria PilarManas and Jorge De Las Heras, 2011, Effects of wastewater irrigation on soil properties and turf grass growth, Water Science and Technology, 2011, 63 (8), 1678-1688.
6. Emamqoli, 2012, Evaluation of the effect of urban wastewater on some soil and plant chemical properties, master's thesis of de-desertification, Natural resources faculty of Tehran university.
7. Hassan Ali Idias,Rana, 2013, Evaluation of using Treated Wastewater on Soil Chemical Properties and Crop Productivity in Gaza Strip, A Thesis Submited In Partial Fullfilment of the Requirements for Degree of Master in Environment Management and Monitoring. Islamic University- Gaza, Plestine.
8. HodaA.A.Galal. 2015, Lon-term Effect of Mixed Wastewater Irrigation on Soil Properties, Fruit Quality and Heavy Metal Contamination of Citrus, American Journal of Environmental Protection, 2015, Vol.3, No.3, 100-105.
9. IlkerAngin, A vahapYaganoglu and MetinTuran, 2004, Effect of Long- term Wastewater Irrigation on Soil Properties, Journal of Sustainable Agriculture, pages 31-42.
10. Irandoost, Mohsen and Ali Salehi Tabriz, 2017, The effect of municipal wastewater on soil chemical properties, Solid Earth Discuss, doi: 10.594/ se-2017- 6.
11. Jafari, mohammad, zarechahooki, tavili, kohandel, 2006, Assessment of the relationship between soil properties and plants species in Qom province, Journal of Research and Development of Natural Resource, No 73.
12. Jimenz-Cisneros B, 1995, Wastewater reuse to increase soil productivity, Journal of Water Science and Technology, 32: 173-180
13. NRC, 1996, use of reclaimed water and sludge in food production, Washington D.C: National Academy Press 70.
14. Omidvar, k, 2006, A study on the temporal- spatial chances for precipitation enhancement in Yazd province, Quarterly Research Bulletin of Isfahan University (Humanities), 20(1), 93-120
15. Qishlaqi, Afshin, Farid Moore and Giti Forghni, 2008. Impact of untreated wastewater irrigation on soils and crops Shiraz suburban area, SW iran, Environ Monit Assess (2008) 141:257-273
16. Rezaeian, Ali, Azarmanafzadeh, Ghane, Esmaeili, Zarezadeh, Mirakbari, Fatahi, 2012, Knowing of Yazd Province,
17. Salehi, Azadeh, Tabari, Mohammadi, Aliarab, 2008, Effect of Wastewater Irrigation on soil and pine trees growth in Tehran, Journal of Forest and populous Research of Iran. Volume 16, No 2, 186-196.
18. Shayanjezi, Mina, Feizi, mohammad, Qorbani, hadi, 2010, Effect of wastewater irrigation in agriculture on some soil chemical properties, The second national seminar of recycled water and wastewater station in water resources management.
19. WHO, 2006, Guidelines for the safe use of wastewater, Excreta and Gray water, Wastewater Use in Agriculture, Geneva 2.