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Feasibility of the use of Bandar Abbas wastewater plant effluent in agriculture

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ABSTRACT

Water shortage in Iran and other arid regions is a limiting factor to produce agricultural products and development of green space. On the other hand, increasing population growth and environmental pollutions have forced the authorities and governmental organizations to look for some solutions to deal with water shortage. In most of countries being faced with water shortage, wastewater effluent can be considered as the cheapest and accessible water resource for irrigation due to being rich in terms of plant nutrients. But, for water reuse, its quality must be known and then, it should be considered for various consumptions correctly. The objective of the present study is to assess the feasibility of the use of treated effluent of domestic wastewater as an important resource for irrigation in agriculture as well as investigating the positive and negative aspects of that, compared to fresh water.

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INTRODUCTION

Increasing population growth along with development of agricultural and industrial activities to increase nutrients; and on the other hand, successive droughts have caused the available surface fresh waters reach the peak utilization in most of countries located in arid regions belt, and consequently, the water resources are over pressured. Moreover, Iran currently is among the countries of which withdrawal from groundwater resources is higher than the international standards.

High consumption of water leads to increase the amount of wastewater. Releasing the raw wastewater in the nature causes environmental pollution and baldy affects the quality of surface and underground flows. Therefore, the necessity of the use of water chains consistent with its quality variation in diverse sections of consumption becomes obvious [1].

In arid and semi-arid regions, utilization of wastewater effluent is much important since, access to high quality ware resources is limited there. Although the volume of wastewater is low compared to the required water volume for irrigation, utilization of the available volume of wastewater effluent leads to the use of high quality waters for more important consumptions [4].

Correct use of municipal wastewater can resolve the problem of surface water pollution and not only causes to preserve water resources, but also, it is so useful for plant growth due to the existence of nutrients.

Existence of the effluent beside municipal centers provides increase of the possibility of agricultural products around these regions. Also, existence of nitrogen and phosphorus in wastewater leads to reduction or elimination of needed commercial fertilizers for agricultural products [5].

In Bandar Abbas city with a population by 500000 persons, 85000 m^3/day wastewater is produced considering per capita consumption of water by 200 liter in 2014. The mentioned amount of produced wastewater includes 85% of water collected in sewer networks. If irrigation is conducted with a good efficiency and controlled, the effluent of treated wastewater of the mentioned city can be used to cultivation of a proper plant with water requirement by 5000 m^3/year. So, 6000 ha of the lands around the city can be irrigated and cultivated. In addition to economic benefit of implementation of the mentioned plan, it is a very effective assistance to preserve soil fertility; since, the existent nutrients in wastewater effluent can provide a considerable

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amount of nutritional requirement of plants. According to the conducted experiments, the mentioned nutrients in Table 1 will be added to the soil during a year [1].

Table 1: Fertility enhancement of the soil irrigated by effluent

elements	Amount of enhancement
Nitrogen (N)	250 kg/ha/y
Phosphorus (P)	10 kg/ha/y
Potassium (K)	30 kg/ha/y

Therefore, nitrogen and a large amounts of phosphorus and potassium which are required for production of agricultural products under normal conditions, are provided. Moreover, some other nutrients and organic matter existent in wastewater effluent can be useful for plant and soil.

The objective of the present study is to assess the feasibility of the use of treated effluent of domestic wastewater as an important resource for irrigation in agriculture as well as investigating the positive and negative aspects of that, compared to fresh water. The importance of implementation of the mentioned plan, is felt further due to the existence of fresh water resources limitations in the southern provinces of Iran particularly during the recent droughts and those consequences on the economy of people life [2].

MATERIALS AND METHODS

2.1. Health parameters of the used wastewater in agriculture:

Chemical organic matter is generally low in municipal wastewater and it should be absorbed in long-term to have no harmful impact on the human health. If wastewater is used in agriculture, the mentioned happening does not occur unless, the wastewater penetrates into drinking water supplies or the labors have not been trained correctly; generally the mentioned cases ignored.

Pathogenic organisms have the greatest role about health quality of irrigation water and unfortunately, a few studies have been conducted on the spread of infectious diseases and practical use of wastewater in agriculture. Nevertheless, Schowal et al. presented a simple instance in this regard. Their study shows that, in the region with parasiticlocal disease by Ascaris and Lyperosomum, the vegetables which are used as raw, are irrigated by untreated wastewater. The mentioned researchers have presented another samples from the west of Germany which approves the accuracy of the mentioned hypothesis severely (Fig.2).

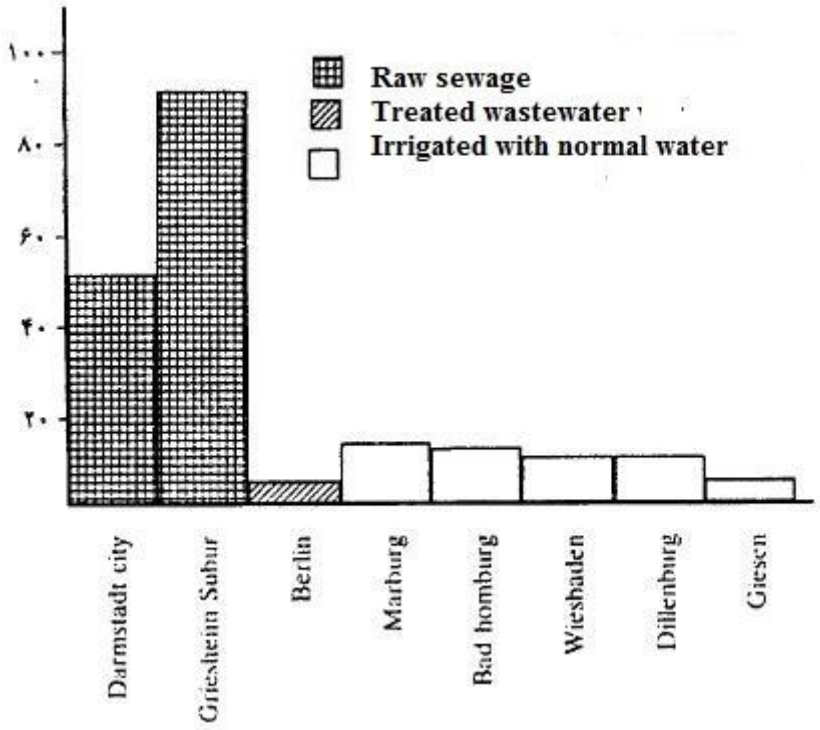

Fig.1: Percentage of Ascaris existent in various samples of Germany' cities based on the type of irrigation water.

According to Fig.1, the use of treated effluent for irrigation can dramatically reduce parasitic diseases and have no impact of the human health.

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2.3. Determination of suitable place for the experiment of the use of effluent for irrigation:

Due to access to a domestic wastewater treatment system and neighborhood of the studied croplands to that, Morvaridresidential complex wastewater was considered as control wastewater treatment plant considering its utilization history of the mentioned effluent in irrigation of citrus fruits and vegetables such as cucumber.

Growing lemon in Tazian region of Bandar Abbas has a long history; so that, according to the available statistics from Agriculture Organization of the province, 43 ha of the lands has been dedicated to lemon planting in 2011. The mentioned species are generally planted in the holes with a depth 1.5 m in rows and those distance vary between 3 and 4 m. irrigation system in whole the region is surface irrigation and only the plant root contacts with water. 10 lit/day water is used for lemon trees. It is notable that, investigation of wet mass of lemon includes only fruit production due to being perennial and evergreen. So, the table of variance is only for the plant fruit.

2-4- Characteristics of the water and effluent used in croplands:

To assess feasibility of the use of domestic wastewater effluent in irrigation of agricultural lands and giving rational reasons about advantages of the use of effluent and the possibility of comparison of crop products which are irrigated by fresh water, a cropland irrigated by fresh water was needed to be considered as control cropland. Since all the croplands of Morvarid Town were irrigated by effluent, it was supposed to irrigate a cropland by fresh water adjacent to the croplands of Morvarid Town. About selection of control cropland, consistency of irrigation method and the amount of irrigation water with the croplands of Morvarid Town was much important. Surface irrigation was considered as irrigation system for both control and main croplands.

2-5- Climatic characteristics and local conditions of the study area:

According to the mentioned contents, climatic conditions and soil type are the factors which affect plant growth. Based on data analysis of weather station of Bandar Abbas since 1975, the minimum absolute temperature is 8.7^0C and the maximum absolute temperature is 47.2 ^{0}C. Generally, the role of precipitation in supplying the water requirement or washing the soil chemical matters was considered negligible during the study and fruit growing due to one year precipitation.

Table 2: Chemical characteristics of irrigation water and the effluent used in the experiment

Studied variable	Amount in irrigation water	Amount in effluent water	Measurement unit
Electrical conductivity	0.7	1.3	Mmmohos/cm
Acidity	7.7	7.5	ppm
Claire	10.2	118	ppm
Mercury	0	0	ppm
Potassium	3.8	29.6	ppm
Magnesium	18.4	31	ppm
Calcium	22	33.9	ppm
Iron	0.06	0.07	ppm

Also, potential evapotranspiration of the studied area was selected using Penman method with respect to the climatic conditions. Accordingly, the amounts of potential evapotranspiration have been calculated in the studied area. According to the values of the mentioned tables, water requirement of each hectare of the studied croplands for lemon is 744.66 m^3 during the growth period.

3. Results:

3.1. The impact of irrigation by effluent on the amount of fruit production of lemon:

Table 3, shows the impact of the treatments of water and effluent on the amount of fruit production of lemon. The treatment T1 (irrigation by effluent) with 3.424 tons lemon fruit for each experimental plot or 34.252 tons per hectare, has a considerable increase in fruit production compared to the treatment T2 with 3.124 tons for each plot or 31.256 per hectare. In other words, there is a significant difference among the experimental treatments by comparison of the variance analysis table at probability level of 5%. But, the mentioned difference is not tangible in the blocks. The phenomenon of synergy or interaction of plants in smaller pieces are the most important reasons for this happening. Also, the increase of products in larger pieces can be observed by evaluating the absolute value of the difference of treatment samples means and those comparison to the cultivated lands value at confidence level of 5%.

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Table 3: Evaluating the variance analysis of the impact of irrigation by effluent on the lemon fruit compared to the irrigation by well water

Irrigation treatment	Weight of lemon fruit (ton)		
	1	2	3
T1: Irrigation by effluent	0.427	3.424	34.252
T2: Irrigation by well water	0.296	3.124	31.256
LSD	0.021	0.031	0.193

Conclusion:

The results of measurement of various variables in the present study showed that, the use of effluent instead of fresh water in irrigation of lemon trees has caused to increase the product and it has enhanced the amount of production from 31.256 ton/ha to 35.2 ton/ha. In other words, it shows 8.74% increase of production per hectare.

The products of the plots irrigated by effluent have the minimum biological contamination. But, those have considerable nitrogen compounds. Although the mentioned amount of nitrogen compounds is not considered in the threshold range of nitrogen compounds concentration for the lemon fruit, but, removing these materials from the effluent of Morvarid Town wastewater treatment plant seems to be necessary due to accumulation of the mentioned compounds in lemon fruit.

REFERENCES

[1] Bahri, A., 1999.Agricultural reuse of wastewater and global water management. Water Sci. and Technol., 40(4-5): 339-346.
[2] Chaney, R.L., 1989. Scientific analysis of proposed sludge rule.Biocycle, 30: 80-85.
[3] Jenkins, C.R., I. Papadopoulos and Y. Styllationou, 1994. Pathogens and wastewater use of irrigation in Cyprus. Proc. of Int. Conf. on Land and Water, 4-8 Sep.,Valenzano, Bari, Italy.
[4] Korboulewsly, N., S. Dupouyet and G. Bonin, 2002. Environmental risks of applying sewage sludge compost to vineyards: Carbon, heavy metals, nitrogen, and phosphorus accumulation. J. Environ. Qual., 31: 1522-1527.
[5] Monte, H.M. and M.S. Esousa, 1992. Effects on crops of irrigation with effluent water. Sci. Technol., 26(7-8): 1603-1613.
[6] Pettygrove, G.S. and T. Asano, 1984. Irrigation with reclaimed municipal wastewater: A guidance manual. Report No. 84-1, California State Water Resources Control Board.
[7] Singh, B.R. and E. Steinnes, 1994. Soil and water contamination by heavy metals. PP. 233-271. *In:* La1, R. and Stewarts, B. A. (Eds.), Soil Processes, CRC Press, USA.
[8] Stevens, D.P., M.J. McLaughlin and M.K. Smart, 2003. Effects of long-term irrigation with reclaimed water on soils of the Northern Adelaide Plains, South Australia. Australian J. of Soil Res., 41(5): 933-948.