Asian Journal of Water, Environment and Pollution, Vol. 15, No. 2 (2018), pp. 171–176.
DOI 10.3233/AJW-180029

Evaluating the Water Quality of Olive Orchards and Negative Effects of Agriculture on Environment

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Received September 13, 2017; revised and accepted February 10, 2018

Abstract: Loshan is a city in the Central District of Rudbar county, Gilan Province and has dry climate. Due to the low rate of precipitation (average 250 mm per year), irrigation of olive orchards depends on the quality of water obtained from different wells. On the other hand, water and soil management of agriculture pay great attention to Rudbar city because its water quality is affected by bedrock. Therefore, based on the different position and geological structure of that region the quality of water is of central importance. In the present study, in order to assess the water quality, 40 samples were collected from wells of olive gardens. The results showed that the salinity of 62.16%, and 27% of waters ranged from 700 to 3000 and more than 3000 microsiemens per centimetre, respectively. Based on Wilcox classification 13%, 60% and 27% of waters were located in c_2s_1, c_3s_1 and c_4s_1 class. Accordingly, it was distinguished that salinity in irrigation water of some wells was higher than normal, which caused salt accumulation and degradation of soil. Therefore, ignoring this subject will be a threat for the garden of the region and surrounding ecosystem.

Key words: Agriculture, water quality, salinity, soil degradation.

Introduction

Water is one of the important limiting factors for agriculture in a dry and semi-dry region of the world. Water deficiency in many regions of the world especially in dry and semi-dry regions is of central importance. Recently in all industrial sectors, need to water has increased, one of these sectors is garden industries. The first reaction of plants against water deficiency is growth reduction. The importance and effect of water on economic, social, cultural and political life of nations is not hidden from anyone. The evolution of humankind is full of examples of the role and importance of water in creating and spreading or destroying various human societies, however, its lack of attention has over time created the conditions for earth water resources to be destroyed, that has led to new desert areas, and so the problem of water crisis has been raised as a global issue.

Based on existing statistics, since the beginning of 20th century to the end of it, water consumption in the world has increased 10 times whereas water resources have remained same. This phenomenon leads to the increase of water demand and extraction, which causes destroying natural balance and environment. And social problems such as the Urmia lake and its related environmental problems, which is the main reason of lawful and unlawful wells around this lake and also dams constructed on rivers leading to this lake. Increasing of yield as a result of increasing population has some environmental consequences such as increasing degree of irrigation, consuming pesticides and fertilizer. The use of high amount of pesticides results in the contamination of underground waters, which is one of the effective factors on quality and quantity of agriculture products. Also it is effective on concentration of soluble salt in soil, which causes cellular dehydration of plant. Besides, it causes a reduction of vacuole and cytoplasm as also metabolic process such as decreasing photosynthesis, decreasing growth, decreasing germination, leaf burn shortage of magnesium and calcium in plant and production of abscisic acid (Bartles and Sunkar, 2005).

In future, the global agriculture will face two important challenges. It is predicted that population of the world in 2050 will increase to 2.3 billion; consequently, in order to supply food, agriculture production should reach 1.7 times more than contemporary production. On the other hand, agriculture land will be exposed to climate changes of land and low water (Ahmad and Prasad, 2012). Hasanuzzaman et al. (2013) and Deranj et al. (1991) showed that 43 million hectares of land under irrigation in dry region of the world is exposed to different processes like salinity, alkalinity, and persistence, but based on Table 2, in view of FAO experts (1995) 27.1 million hectares of land of the country is exposed to salinity. Ghassemi et al. (1991) believed that about 20% of the whole irrigation land (227 million hectares) in the world is exposed to salinity (Table 1). In Iran, 5.8 million hectares of land is under irrigation and 30% (1.7 million hectares) of them is exposed to salinity.

Mclay et al. (2001) showed that activities of human being for increasing product at the unit of the surface decrease the quality of underground water. Gold (2007) claimed that water resources in the world are decreasing and about 85% of the sweet water of the world is consumed at agriculture section; therefore, the use of water resources for agriculture production is effective in decreasing the quality and quantity of water. Gonzalez Dugo et al. (2010) stated that limitation of water resources in the dry and semi-dry region naturally decreases the quality and quantity of water and soil resources.

Despite of limited water resources and improper time and place distribution at the geographical zone of the country, unfortunately, efficiency of using these resources is low and damages belong to agriculture section. Salinity is an important tensioning factor limiting utilization of plants. A significant section of

Table 1: Level of lands exposed to second salinity in irrigating land in the world (Ghasemi et al., 1995)

Country	*Land area subject to salinity (%)*	*Land area subject to salinity (M Ha)*	*Area of irrigation (M Ha)*	*Area of cultivation (M Ha)*
China	15	6.7	44.8	97
India	17	7	42.1	169
Mid-Asia	18	3.7	20.5	232.5
U.S.A.	23	4.2	18.1	190
Pakistan	26	4.2	16.1	20.8
Iran	30	1.7	5.8	14.8
Thailand	10	0.4	4	20
Egypt	33	0.9	2.7	2.7
Australia	9	0.2	1.8	47.1
Argentina	34	0.6	1.7	35.8
South Africa	9	0.1	1.1	13.2
Sub total	20	29.7	158.1	842.8
Total	20	45	227	1474

Table 2: Level of lands exposed to salinity in Iran (FAO, 1995)

Land area subject to salinity (M Ha)			*Lands under irrigation (M Ha)*	*Area of cultivation (M Ha)*	*Total area of country (M Ha)*
Total	*Alkaline/solonetz*	*Saline/solonchak*			
27.1	0. 7	26.4	9.4	18.2	163.6

agriculture lands in the world are affected by salinity and the speed of developing salinity are estimated about 1.5 million hectares per year.

Velikova et al. (2000) identified the salt region and they decreased the tension effect of created salinity by planning and decreasing the performance of plants. Analyzing water quality is an important section of underground water. Qualitative variety of underground water physically and chemically is a function of features of geology and human activity in each region. In hydrogeochemical studies of the region, the proper quality of underground water with goals of drinking, agriculture, and industry were identified. Water consumption with unfavourable quality in agriculture moreover decreases product and creates a problem for irrigating systems, removes physical characteristics of soil and conclusion is a wasteland. So we should pay attention to qualitative aspects of water and existence of harmful factors. Constant agriculture are systems where sources are kept balanced. Production and suitability and other cases are not only constant for farmers but also for society. Neshat and Zeinolabedini (2013) in a survey of proceeding of salt water on quality of irrigation water and soil's physical and chemical characteristics in pistachio orchards of Sirjan represent that water quality of irrigation has direct effect on soil factors and this action represents effect of unconventional water on pH and all parameters of irrigation water quality especially salinity of lands. Also in regions that have been affected by proceeding salt water represented that measurement degree of parameters is as regarding existing standard they are unusable for any cultivation and practically production of pistachio (due to high economic value) is not possible with these waters. Naghavi (1996) showed that in some region of pistachio cultivation, irrigating and its management changed the quality of soil. The result showed that in some region irrigating caused salinity and alkalinity of the soil; therefore, the effect of salinity of lands depends on the quality of water irrigation regarding the type of cation and anion and management of irrigation.

Jafari et al. (2002) claimed that studying the dessert land of agriculture around Damghan desert after a period of cultivation and irrigating with salt water, the degree of electricity conductivity (EC), sodium chloride, bicarbonate, calcium, magnesium, and ratio of sodium attraction was increased, where this increase of salt disarranged the balance of cation and anion in soil and caused creating disorder at absorbing required food of plants. Increasing EC and soluble salty materials destroy soil structure and cause problems in drainage, whereas quality of using water decreases annually, soluble salty materials increases and has an unfavourable effect on soil characteristics that have the main role at being land to desert. Previous studies showed that bedrock of flow is an effective factor in chemical combination of water. Gibz (1970) suggested that chemical combination of surface water was controlled by three important factors including geological layers, the degree of rain, and balance between salt, which resulted from vapour and rain. Eilers et al. (1992) determined factors affecting the water quality as geological changes, type of soil and water flow as affecting regional factors at small scale.

Sundaray et al. (2009) in a case study in river of Mehand (India), evaluated the quality of river for six different time periods and in 31 stations using mathematical relation and parameters such as absorbing sodium, sodium carbonate, permeability of water in soil and degree of magnesium calculated capability of water for agriculture consumption that showed result with Wilcox diagram. Based on Wilcox index all samples of different regions were located in the classification of excellent to good (low salinity to moderate with low sodium) that for all soils and products sensitive to salinity it was proper. Bartram and Balance (1996) in report of WHO and UNEP have related quality of surface and underground which depend to natural factors of geology, topography, meteorology, hydrogeology and biological in the area of basin and seasonal changes at mass of runoff, condition and type of weathering and level of waters; natural severe changes resulted from mentioned factors may only be observed in one waterway. On the other hand, human activities have significant effect on water quality. Some of these effects are the result of hydrological changes like making a dam, dryness of ponds and deviation in direction of flow. Meteorological factors like quantity and the severity of rain by affecting the cycle of water hydrology affect quality and quantity of water resources. A natural process like vapour and transpiration, soil humidity, natural erosion and weathering land use, agriculture activity, and human meddling in water cycle affect water resources.

Material and Methods

Rudbar city is located in north of Iran in mountainous region. Its climate is affected by dry and semi-dry weather of central region. Regarding weather of this region, especially Rudbar city has Mediterranean weather and growth of olive trees in this region is witness of subject. This region is located in the direction of permanent winds of Sefidrud valley. Loshan region is a city in the Central District of Rudbar county with very dry climate and low precipitation. Its moderate temperature is 10 degree more than Rudbar. Regarding climate features and shortage of water resources, existence of great garden of olive in this region has special importance. Surveying of water quality used in gardens that is usually wells besides Shahrood river. They are irrigated with by saltwater; olive yield will have severe wane and soil of the region will be saline and consequences related to salinity of soil are possible. Also, output drainage enters into Sefidrud river, which is a threat for Gilan province. Therefore considering the quality classification of the water based on instruction of FAO is the goals of this project. This region includes 2000 hectares of olive gardens. In this study about 40 water samples from wells and rivers of the region, used for irrigating, were sampled in July.

Result

pH

In this study, mean pH of waters was 7.6, and maximum and minimum pH respectively were 8.05 and 7.05. Besides, pH of 29.7% was less than 7.5 and 70% of them had pH of 7.5 and more although these waters have alkaline feature. pH of this soil is less than 8.5, but based on this method pH of all the waters was between 6.5-8.4 in this area, that did not have any limitation.

Electrical Conductivity

Mean EC of water samples was 2457.3 microsimens per centimetre, and minimum and maximum EC were 531 and 14,670 microsimens per cm in well, respectively. Based on FAO-29 instruction the results showed that the salinity of 10.8%, 62.16% and 27% of waters respectively are less than 700 microsimens per centimetre, between 700-3000 microsimens per centimetre, and more than 3000 microsimens per centimetre. Moreover, based on Wilcox method 13.5%, 56.7% and 29.7% of waters respectively are located in class c_2 (less than 750 microsimens per centimetre), c_3 (waters between 750-3000 microsimens per centimetre) and class c_4 (more than 2250 microsimens per cm EC). The reason of high salinity can be related to salt layer in depth of soil and salty marl soils, which extensively are observed by outcrop in the form of badland or deep gully near Loshan region toward Zanjan.

Figure 1: Olive garden of studying region.

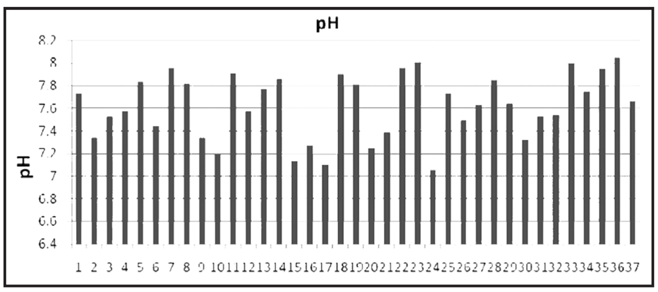

Figure 2: Changes of pH in water samples in the region.

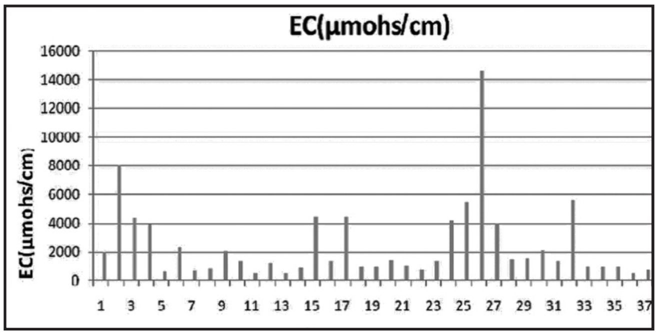

Figure 3: The result of electrical conductivity changes in olive gardens.

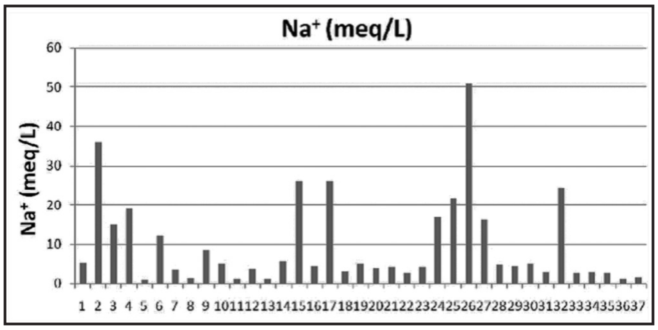

Figure 4: The result of changes of sodium in olive gardens.

Sodium Absorption Ratio (SAR)

Mean SAR is 3.09 and minimum and maximum respectively are 0.53 and 8.48. Therefore, all waters are located at class S_1. Based on Wilcox classification about 13% of waters are in class C_2S_1 and 60% of waters in class C_3S_1 and 27% of waters in class C_4S_1, which is dangerous for agriculture and using these waters have some consequences such as sweeping, wiping, wooding of branches and necrosis of leaves in gardens of the region. However, based on the recipe of 29-FAO that 62.2% of waters have SAR less than 3 without any limitation, and 37.8% of waters have SAR between 3-9 with low to moderate limitation. In many plants, especially plants resistant to salinity, sodium and absorbed chloride are collected in root and shoot and do not transfer to leaves that cause resistance to the salinity of these plants. Regarding the importance of sufficient concentration of calcium ion in soluble soil for preventing poisoning of another element like sodium and magnesium, usually critical level of this factor in the form of a ratio of calcium to the concentration of other cation or ratio to sodium is expressed. In salt soils and after the use of salt water, the first nutritional problems were related to sodium ion ratio to calcium. Grains have much sensitivity to calcium deficiency due to additional sodium. A high ratio of magnesium to calcium can disrupt the nutritional balance in a plant and a new threat for water of agriculture is increasing magnesium to calcium in waters.

Chloride (Cl^-)

The result of FAO-29 instruction showed that 29.7% of waters have chloride less that 4 meq/L without limitation, 27% of waters have chloride between 4-10 meq/L with low to moderate limitation, and 43.2% of them have chloride more than 10 meq/L, which have severe effect on soil and plant. Existing chloride in plants in comparison with sodium usually was more sensitive index than salinity and by increasing salinity concentrate in plant rapidly and usually its content in plant bodies is more than sodium. Chloride concentration in plant and its damage to leaf can decrease photosynthesis and decrease production. Increasing chloride absorption to sodium even can decrease absorption of another anion like nitrate.

Total Result

Salt resulted from dissolution enter into water of well, which not only causes salinity of water but also salinity of soils. On the one hand, by increasing pH of the water, calcium and magnesium is precipitated in soil and leads to an increase in sodium of waters. This problem can have two important effects that causing the creation of a hard layer of low penetration in under layers due to sedimentation of calcium carbonate and by increasing sodium, SAR index increases; so using such waters for agriculture consumption leads to salinity and alkalinity of soil wherein problems are more severe than salt water. Finally, in long-term these soils will lose their quality that will have uncompensational ecological and biological effects.

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