Assessment of water quality of Garmat Ali river for irrigation purposes

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Abstract. This study investigates the suitability of Garmat Ali river (Iraq) for irrigation uses. Two stations were chosen: station A; far from any polluted water discharge point, and station C; near to a very contaminated water discharge point). Water samples were picked up and tested for pH, electrical conductivity, total dissolved solids, sodium, potassium, calcium, magnesium, bicarbonate, sulfate, chlorine, and nitrate. Three samples were collected in January and March 2019 from each site, to reflect the wet season in Iraq. Besides the classification of water quality parameters of Garmat Ali river for watering, other parameters were also calculated, such as sodium adsorption ratio, soluble sodium percentage, exchangeable sodium percentage, magnesium hazard, kelly ratio, permeability index, and potential salinity. According to the Food and Agriculture Organization (FAO) guidelines, the overall results showed that the salinity and chlorine were within the range that causing severe problem to plants. In addition, sodium toxicity and hazard were classified the river water as unsuitable for irrigation. Potential salinity was under the class of unsuitable for irrigation. Bicarbonate hazard was under the category "slight to moderate". However, the remaining parameters were within the accepted range. Most of the contaminants were higher in the polluted station.

1 Introduction

The main water resources in the world are the rivers, glaciers, ponds, lagoons, rainfall, and ground water. These resources are generally used either for drinking or for many economic fields, such as irrigation, animals' production, manufacturing, fisheries, hydropower production, and other activities [1]. However, it is reported that around seventy percent of the water consumption in the world is for agricultural uses, and the major part of this quantity is utilized for grasses and plants' irrigation. Whereas, the rest is consumed for animals and other farm activities.

Rivers are counted to be the main sources of watering, especially in the tropical areas. This because the rainfall in these regions is not reliable for irrigation purposes as the precipitation is highly irregular and it is only ranged between 100 and 200 mm annually [2]. But, these sources may comprise noticeable amounts of chemical materials and dissolved salts that could decrease the plant production or adversely affect the soil productivity [3]. [4] mentioned that the irrigation water, may be of bad quality, as it carries the pollutants that are occurred naturally in the rivers environment or generated by humans' (industrial or domestic) activities or both of them. Therefore, studying the quality of irrigation water is necessary for safe usage.

Many studies have been reported to investigate the quality of surface and ground water in Iraq and other countries for irrigation. This evaluation is very important, especially in arid and semi-arid areas that suffer from water scarcity problem, to specify the characteristics of water based on standard limits. [3] found that the restriction degree of using the Al-Kifl river in Al-Hindiya city (Iraq) for irrigation is low. [4] showed that river Diyala water (Iraq), to some extent, is appropriate for irrigation. The water of the Benin-Owena river basin (Nigeria) has been evaluated as moderately acceptable for irrigation [5]. [6] assessed the physicochemical properties of Shatt Al-Arab river and its branches (Iraq) in 2016. Authors concluded that the river water belongs to medium class, and the branches classification was within the worst case. [7] evaluated the water characteristics of East Hammar marsh in Iraq. The water quality (WQ) of Garmat Ali river has been examined during 2015-2016 based on the temperature, salinity, and pH [8], and the river water classified as a worse. However, these parameters were not enough for full evaluation. Therefore, the study of irrigation WQ of Garmat Ali river has become essential to show whether the water is appropriate for land watering and safe to plants and soil.

The aim of present research is to evaluate the suitability of Garmat Ali river for irrigation purposes by measuring and analyzing the irrigation WQ parameters of the river. These parameters are included: electrical conductivity (EC), total dissolved solids (TDS), sodium adsorption ratio (SAR), kelly ratio (KR), potential

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