Performance Evaluation of Agricultural Drainage Water Statistically – A Case Study

Mahmoud Nasr¹, Hoda Farouk Zahran²

¹Sanitary Engineering Department, Faculty of Engineering, Alexandria University, P.O. Box 21544, Alexandria, Egypt, e-mail: mahmmoudsaid@gmail.com
²Plant Production Department, Arid Land Cultivation Research Institute, City of Scientific Researches and Technological Applications, Alexandria, Egypt, e-mail: hfzahran@gmail.com

Abstract. Agricultural drainage water could be a source of water for irrigation in Egypt. A case study of an agricultural drainage water near El- Dare region – Borg El Arab City Alexandria, Egypt. Some Physical and chemical parameters (pH, temp, TDS, DO, EC, Salinity, NO₃–N, Cl⁻) were measured on site during seasons of 2014, 2015. By statistical analysis from Min, Max, range, mean, SD and median a performance evaluation for this agricultural drainage water resource performed. In Egypt, Water quality standards have been developed governing the treatment of agricultural drainage water. The guidelines aim at protecting the natural environment from wastewater – related pollution.

Keywords: Agricultural drainage water- drainage water reuses- Egyptian standards - water quality.

1 Introduction

Safe reuse and disposal of water requires an understanding of the characteristics of the drainage water (Nasr, 2015). Water quality is a description of biological, chemical, and physical characteristics of water (El Gohary, 2015). The water quality is normally assessed by measuring a broad range of parameters (e.g., temperature; pH; electrical conductivity (EC); turbidity; and the concentrations of a variety of pollutants, including pathogens, nutrients, organics, and metals) (Abdel Azim, 2000). In Egypt, water quality standards have been developed to govern the treatment of agricultural drainage water (El-Kady, 1999). The guidelines aim at protecting the natural environment from wastewater - related pollution. Those rules are illustrated in several articles and reports as follows (http://www.afdb.org; APRP, 1998; Drainage Research Institute, 1995; Egyptian Environmental Affairs Agency, 1992; EHCW, 1995) : Law 48/1982 Regarding the protection of the river Nile and waterways from pollution - Article 12: Conditions for drainage water reuse; Ministerial Decree 8/1983 on Law 48/1982 Concerning reuse of drainage water -Article 65: Standards for mixing drainage water with canal water (reuse) by the ministry of water resources and irrigation; Law 12/1982 Regarding the irrigation and drainage - Article 31: Specifications of the drainage water network established

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according to the ministry of water resources and irrigation - Article 48: Conditions for drainage water reuse in Irrigation purposes determined by the ministry of water resources and irrigation; Ministerial Decree 44/2000 Regarding the Amendment of Law 93/1962 on the drainage of liquid wastes - Article 15: Specification of the irrigated lands - criteria for types of plants for each type of wastewater treatment - environmental and health precautions.

2 Study area

Agricultural drainage water was near El- Dare region – Borg El Arab City Alexandria, Egypt.

3 Determination and Statistical Analysis of Samples' Data

Physical and chemical parameters (pH, Temperature [temp], Total Dissolved Solids [TDS], Dissolved Oxygen [DO], Electrical Conductivity [EC], Salinity, Nitrate as Nitogen Concentration $[NO_3-N]$, Chlorides [Cl⁻]) were measured on site during seasons of 2014, 2015 using Multiparameter water quality probe- Aquaprobe® AP-7000, England according to Standard Methods for examination of Water and Wastewater (Eaton, 2005).

and next statistical analysis from minimum (Min), maximum (Max), range, mean, standard deviation(SD) and median (Walker, 2002) for data were performed as shown in table (1) and some formula for statistical calculations are shown in table (2).

Parameters	Min	Max	Range	Mean	SD	Median
рН	7.90	10.30	2.40	8.70	0.90	8.30
Temp (°C)	18.50	21.90	3.40	20.30	1.00	20.10
TDS (ppm)	1.37	5.70	4.32	2.84	1.31	2.38
DO (%)	0.90	48.60	3.90	1.40	1.00	1.20
EC µs/cm	2.05	9.00	6.95	4.18	2.13	3.46
Salinity (g/kg)	1.06	2.60	1.54	1.72	0.46	1.69
NO ₃ –N (mg/L)	0.01	0.55	0.36	0.39	0.11	0.39
Cl (mg/L)	14.80	155.50	140.70	94.19	45.70	92.00

Table 1. Statistical Analysis for Physical and Chemical Characteristics for Collected Samples

Table 2. Statistical Analysis Formula of Data.

Measure	Formula	Description	
Mean	$\Sigma x/n$	Balance point	
Median	n+1/2 Position	Middle value when ordered	
Mode	None	Most frequent	

4 Reuse of drainage water

- Official reuse: by capturing drainage flows in main drains and mixing them with main canal water at centralized mixing pump stations.
- Intermediate reuse: water in a branch drain can be captured when its water quality is appropriate. It can avoid unnecessary losses of branch drain water by using it before being connected to a highly polluted main drain.
- Unofficial reuse: is defined as farmer's direct reuse of drainage water without pre-permission from Ministry of Water Resources and Irrigation. It exists wherever canal water shortage is recorded; i.e. mainly at canal end.

5 Conclusions

Based on the drainage water quality analysis of the drain and the Egyptian standards for the drainage water reuse, it's concluded that water quality of the drain doesn't meet the standards for direct reuse in irrigation. Vegetables irrigated with such drainage water are not safe for human and animal consumption. Therefore, a remediation solution using physical, chemical and/or biological methods is recommended.

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