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PERFORMANCE EVALUATION OF THE SUBSURFACE DRAINAGE SYSTEM IN EL-BOSTAN AREA, EGYPT

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ABSTRACT

This study is conducted to assessment the performance of subsurface drainage system in the 2100 ha; located in El-Bostan region, El Behira governorate Egypt (30^o 47' 00" and 30^o 51' 00" N, 30^o 23' 00" and 30^o 25' 00" E). Three sub main drains, El-Amlak No. 7, El-Amlak No. 8 and El-Amlak No. 9 served the studied area. 105 piezometers were installed in selected sites of studied area. Twenty one sets of PVC piezometers were installed perpendicular on the both sides of sub main drain lines at depth of 120 cm from soil surface. Each set was consisted of 5 piezometers were installed at 0.4, 2.5, 5, 15 and 30 m away from the lateral drain. The drainage assessment parameters revealed that, the average drainage intensity factor values were 0.029, 0.018 and 0.030 day^{-1} for sub main drains No. 7, 8 and 9 respectively. The average values of days after cessation of recharge (t_A) values in piezometers at midway between lateral drains for sub main drains No. 7, 8 and 9 were 17.20, 23.69 and 13.61 days, respectively. The average value of water table draw down in piezometers sites at midway between drains represents the tile drainage system (sub main drains) at studied area was low (2.33 cm/day), this low value of water table draw down continuously caused the raising of height water table above the drains. Moreover, the average value of water table height above the drains level at midway between drains before the next irrigation for the tile drainage system in the studied area (77.13 cm) is required 33 days as well as 15 days irrigation interval to below the drains level. Thus, the tile drainage system in this area is very poor. The average value of head loss fraction for the tile drainage system in studied area was 1.340. The entrance resistance average of the tile drainage system in studied area was 7.267 day/m. The values of head loss fraction and entrance resistance revealed that the drainage system performance very poor. The obtained value of depleted fraction (DF) was ranging between 0.51 and 0.57 (table 5) which is considered normal for arid region. The critical value of DF = 0.55 implies that if ETa at any month is less than 0.55 (Pe + Vc), a portion of this available water goes into storage, causing the water table to rise under inefficient drainage system.

Keywords: *performance of tile drainage*, *drainage intensity factor*, *days after cessation of recharge*, *water table draw down*, *head loss fraction*, *entrance resistance*

INTRODUCTION

Drainage is an essential tool to prevent water logging and salinity of soils. Only about 190 Mha, or 13% of the world's arable land, is provided with some sort of drainage (ICID, 2003**).** In Egypt the drained area is about 3.0 Mha (Abdel-Dayem et al., 2007). Many of cultivated areas which have been provided with subsurface drainage system suffer from some problems such as sedimentation; water logging and salinity. Moreover, these systems have passed their technical and economical lifetime, which is estimated between 25 and 40 years (Van Leeuwen and Ali 1999).

Corrugated PVC pipes with a diameter of 100 mm are used for the field drains (Nijland et al, 2005). The field drains have an average length of 200 m and a design slope between 0.1 and 0.2%. Collector drains are spaced at 400 m and consist of pipes with increasing diameter.).The main drainage system is used to convey the water away from the farm area and an outlet is the point of safe disposal of the drainage water (Ritzema, 2014)**.** The flow of water towards drains can be divided into the follow components: horizontal component between the midway and the drains, radial component in vicinity of the drain below the depth, and an entrance component between the wall of the trench and the inside of drain pipe. At each stage there is an additional resistance and corresponding additional head loss (Cavelaars et al., 1994).

The performance of a drainage system does not age dependent but on the other natural factors like human perception and installation condition (Katkevicious *et al*., 2000). It is possible that an old drainage system may work properly even after 20 years while on the other hand a newly installed system may fail just after installation due to inappropriate design or unsuitable drainage material (Stuyt *et al*., 2000). Dieleman and Trafford, (1976) classified drainage performance according to flow head loss fraction as follows smaller than 0.2 the performance considered good, 0.2 - 0.4 considered moderate 0.4 - 0.6 considered poor and larger than 0.6 considered very poor. Moreover the classes according to flow resistance values (d/m) smaller than 0.75 the performance considered good, 0.75–1.50 the performance considered moderate, 1.50 – 2.25 the performance considered poor and larger than 2.25 the performance considered very poor. Also, the drainage system performance was classified based on flow head loss value (m) as smaller than 0.15 the performance considered good,0.15–0.30 the performance considered moderate, 0.30–0.45 the performance considered poor,larger than 0.45 the performance considered very poor.This study was carried out to assess the performance of the existing drainage system by using different parameters.

MATERIALS AND METHODS

This study was carried out at El-Bostan area El Behira governorate which located at (30^o 47' 00" and 30^o 51' 00" N, 30^o 23' 00" and 30^o 25' 00" E). The study area was about 2100 ha; its boundaries were El Nubariya canal as a main canal and Sidi Eissa drain as a main drain. The selected area was divided to three regions normally with four sub main irrigation canals named El-Amlak No. 4, El-Amlak No. 5, El-Amlak No. 6 and El-Amlak No. 7 irrigation canals. In addition to 3 sub main drains El-Amlak No. 7, El-Amlak No. 8 and

El-Amlak No. 9 drains, (fig 1).The soil textural class was sandy loam with average soil saturated hydraulic conductivity value of 0.56 m/day (Table 1). The maximum and minimum temperature ranged between 19.8 and 34.7 ◦C and 5.6 to 19.5 ◦C, respectively. A tile drainage system was installed in this area during the years of 2003 – 2004. Water logging and salinity problems were observed in the study area after the installation of the tile drainage system. So, the assessment of the tile drainage system was essential.

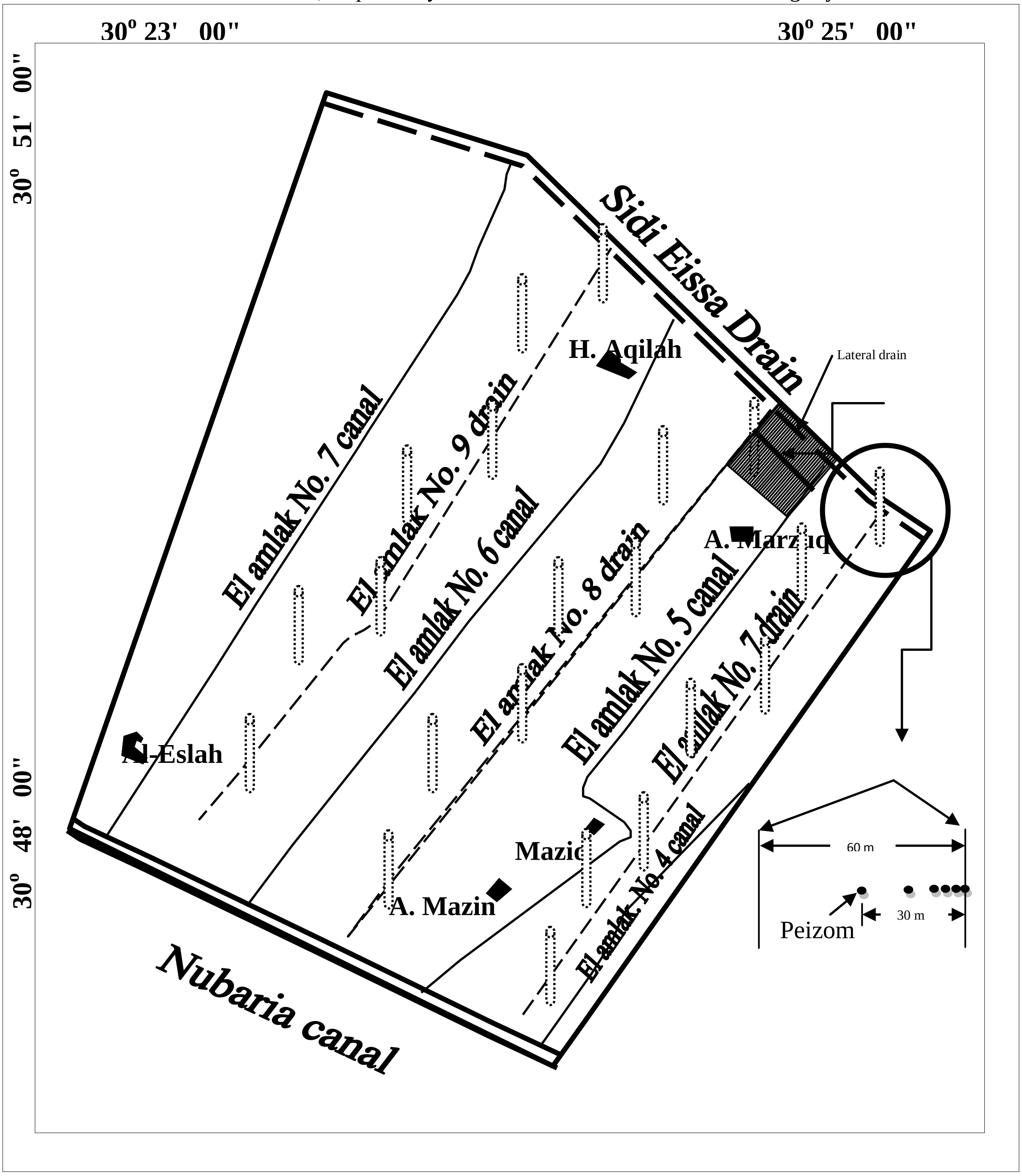

Fig. (1): A map representing the study area and the site of peizometers network sets

Table (1): Physical properties of the soil at the study area

Sand %	**silt**	**clay**	**Texture class**	**Ks** m/d	**ρb** Mg/m^3	**porosity** %
81.01	7.86	11.13	SL	0.56	1.57	40.75

The drainage system in the studied area includes the open main drain (Sidi Eissa) and three open sub main drains (El-Amlak No. 7, 8 and 9) as well as network of tile drainage (lateral drains and collectors). The measurement of lateral diameter, the spacing between lateral drains and length, diameter and slope of collectors were done to estimate the lateral drain slope and the depth of the drain was measured at each quarter of drain length from the outlet of lateral drain. The total discharge of drains, m^3/day, was measured during the period of study (5/2012 to 3/2014.) Also, the water table depth was recorded and hydraulic head values were estimated. The lateral drains of the tile drainage system in the studied area were buried on 1.20 m soil depth with 0.20 % slope. The length and spacing between lateral drains were 217 and 60 m, respectively. The design and dimensions of the manholes in the studied drainage system are the standard as described by Stuyt *et al.* (2005).

105 observation wells were installed at selected sites in the studied area (Figure 1). Twenty one sets of PVC observation wells (5 cm inside diameter and 175 cm length) were installed in perpendicular in soil of the served area of sub-main drain lines at depth of 120 cm from soil surface. Each set was consisted of five observation wells which installed at each studied lateral drain, Fig. (1). Five observation wells were installed at 0.4, 2.5, 5, 15 and 30 m away from the lateral drain. The depth of water table was recorded by a measuring tape inside the observation wells after irrigation and before the next irrigation time (start and end of the irrigation interval), then the hydraulic head was calculated.

The following performance parameters were practiced for the drainage system

1. Depleted fraction (DF)

To assess performance of irrigation and drainage (assess the use of various resources), the plotting of indicator values against another indicator or parameter that influences the value of the indicator is suggested here.The depleted fraction (DF) this indicator (DF) relates the actual evapotranspiration from the selected area to the sum of all precipitation on this area plus surface water inflows into the irrigated area (typically irrigation water). It is defined by Molden and Sakthivadivel, 1999 as:

DF = ETa/ (Pe+Vc)

Where:

ETa = actual evapotranspiration from the command area, mm/month.

Pe = effective precipitation on the command area, mm/month.

Vc = volume of surface water flowing into the command area, mm/month.

2. Drainage intensity factor, (α)

Drainage intensity factor, day^{-1}, was determined according to Dieleman and Trafford, 1976 ($\alpha = (2.303 \log h_o/h_t)/II$) where: h_o is the height of water table above the drain level at midway between drains after irrigation time, t = zero, m. h_t is water table height value above drain level at midway between drains at the end of irrigation interval, t = t, m and II is irrigation interval, day.

3. Days after cessation of recharge (t_A)

Days after cessation of recharge were calculated according to Ritzema, 2006 (**$t_A = 0.2/\alpha$**) Where; t_A is days after cessation of recharge, days and α = drainage intensity factor, day^{-1}.

4. Water table drawdown (WTDD)

Mean time studied irrigation intervals, the rate of water table draw down, cm/day, was determined according to Dieleman and Trafford, 1976 ($WTDD = (h_o - h_t)/II$)

Where: h_o and h_t and II are as defied previously.

5. Head loss fraction(h_{lf})

Head loss fraction was calculated according to Stuyt, *et. al.*, (2005) by the following formula:

$h_{lf} = h_e / h_{tot}$

Where; h_e is entrance head loss represents the loss in hydraulic head value into piezometer was installed at 0.4 m from the drain, m and h_{tot} is total head loss for flow into a drain represents the hydraulic head loss values into piezometers were installed at 0.4, 2.5, 5, 15 and 30 m away from the drain, m (FAO, 60, 2005)

6. Entrance resistance (r_e)

The entrance resistance was calculated for the studied piezometers sites using the following formula according to Dieleman and Trafford (1976):

$\Gamma e = h_e / Q$

Where; r_e is entrance resistance, day/m, h_e is entrance head loss represents the loss in hydraulic head into observation wells installed at 0.4 m from the drain, m and Q = drain discharge, m^2/day = m^3/day per m drain length.

RESULTS AND DISSCUTION

The evaluation parameters of drainage system performance

1. The drainage intensity factor (α), day^{-1}

The drainage intensity factor considered an important parameter in assessing the tile drainage system and important in the interpretation of tile drainage data, whereas this parameter gives a strong base for the selection of a proper drainage system. Also, the drainage intensity factor value is a good indicator to the efficient drainage process. The obtained results in figure (2) Showed that the average values of drainage intensity factor (α) were 0.029, 0.018 and 0.030 day^{-1} for sub main drain No.7, 8 and 9, respectively. This means that the average value of drainage intensity factor (α) of tile drainage system in study area was low (0.026 day^{-1}). This attributed to the low value of hydraulic conductivity of these soils, the wide spacing between the tile drains in such low permeable soils and compacted soil within the trench zone occurring after drainage installation. This lead to a failure in the system as a result of sealing process. These reasons might be collectively lead to low the drainage intensity factor Stibinger (2005)

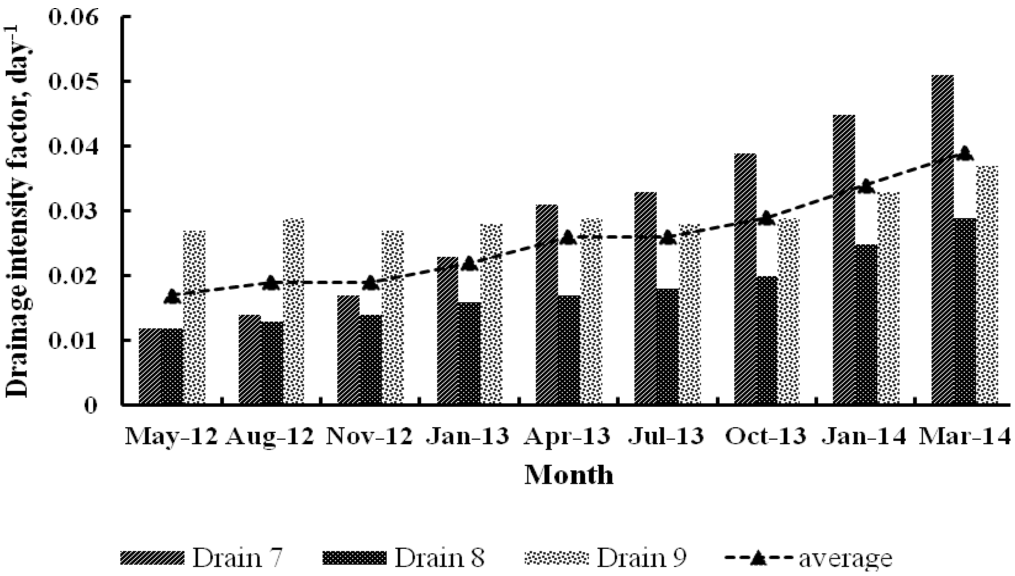

Fig. (2).Average values of drainage intensity factor for studied piezometers at midway between drains for the representative sub main drains of studied area during 5 /2012 to 3 /2014.

2. Days after cessation of recharge (t_A)

Days after cessation of recharge are a guideline to study some possible problems that can occur in tile drainage system to describe the water flow at entry into lateral drain. Days after cessation of recharge **(t_A)** refers to the time needed for applied water to infiltrate and percolate to a suitable depth of the root zone to encourage the roots to grow. The results in Table (2) indicate that the average $\mathbf{t_A}$ values at mid way between lateral drains were 8.60, 11.85 and 6.81 days for sub-main drains No. 7, 8 and 9, respectively with an average value 9.08 days This value is highly harmful for the cultivated crops whereas the root zone is merged with water at recession time. Thus, the crop productivity of the studied area are low (Brouwer et al. 1985).

Table (2): Average values of days after cessation of recharge (t_A) of the studied area at mid-distance between drains Ritzema (2006).

Days after cessation of recharge, days				
Month	**Sub-main drain**			**Average**
	7	**8**	**9**	
May-12	16.67	16.67	7.41	13.58
Aug-12	14.29	15.38	6.90	12.19
Nov-12	11.76	14.29	7.41	11.15
Jan-13	8.70	12.5	7.14	9.45
Apr-13	6.45	11.76	6.90	8.37
Jul-13	6.06	11.11	7.14	8.10
Oct-13	5.13	10.00	6.90	7.34
Jan-14	4.44	8.00	6.06	6.17
Mar-14	3.92	6.90	5.41	5.41
Average	8.60	11.85	6.81	9.08

3. Water table draw down (WTDD)

Water table draw down refers to the water table movement down through the soil profile and then to the drains. It considers as a good indicator for the relation between soil saturated hydraulic conductivity and the drainage system. The results in table 3 showed that the average values of water table draw down at midway between drains were 2.53, 1.8 and 2.64 cm/day represents the sub main drains 7, 8 and 9, respectively, Fig. (3).The average value of water table draw down of the studied area was low (2.33 cm/day).This low value of water table draw down might be due to the low value of soil saturated hydraulic conductivity under water table, whereas the Ks values ranged from 0.263 to 0.950 m/day and classified moderately slow to moderate (NRCS, 2006) with average of 0.574 m/day (moderate). These low values of K due to the fine sand particles might be caused partial sealing for some soil pores, consequently, the K values decreased, NRCS, (2006). This is caused the raising of height water table above the drains level at midway between drains before the next irrigation to 77.13 cm which is required 33 days plus 15 days irrigation interval to downward below the drains level. Thus, the tile drainage system in this area is very poor (Boelter and Gordon, 1974).

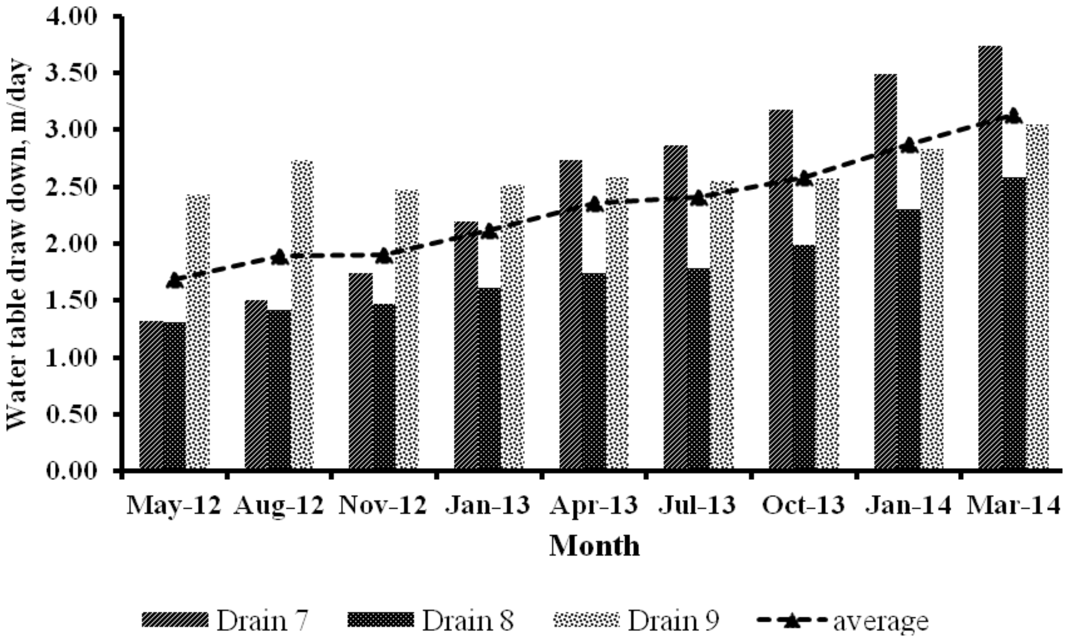

Fig. (3).Average values of water table draw down in piezometers sites at midway between drains represents the sub main drains in studied area during 5/2012 to 3/2014.

Table (3): Average values of head loss fraction of studied area during 5/2012 to 3/2014.

Month	Head loss fraction Sub main drain 7	8	9	Average
May-12	1.667	1.645	1.219	1.510
Aug-12	1.858	2.033	1.491	1.794
Nov-12	1.402	1.493	1.142	1.346
Jan-13	1.429	1.504	1.148	1.360
Apr-13	1.209	1.464	1.152	1.275
Jul-13	1.07	1.429	1.149	1.216
Oct-13	1.105	1.371	1.166	1.214
Jan-14	1.086	1.366	1.137	1.196
Mar-14	1.057	1.304	1.087	1.149
Average	1.32	1.512	1.188	1.340

4. Head loss fraction (h_{lf})

The average head loss fraction values were 1.32, 1.51 and 1.19 for sub main drains 7, 8 and 9, respectively, Table (3). The general average value of head loss fraction for the entire drainage system in studied area was 1.34. This value is indicated that the drain line performance of the tile drainage system is very poor (the head loss fraction is more than 0.6; the tile drainage system is very poor according to NRCS, 2001).

5. Entrance resistance (r_e)

The average value of entrance resistance for observation wells sites represents the sub main drains ranged from 5.90 to 9.92 with 7.56 day/m as average, 4.98 to 7.49 with 6.02 day/m as average and 5.42 to 9.03 with 6.26 day/m as average for the sub main drains7, 8 and 9, respectively, Tables (4).The average value of entrance resistance of the tile drainage system in studied area was 7.267 day/m. This value is indicated that the drain line performance of the tile drainage system is very poor (the entrance resistance is more than 2.25 day/m, the tile drainage system is very poor according to NRCS, 2001 and Dieleman and Trafford 1976. Also, revealed that the increase in resistance with time is a result of decreasing hydraulic conductivity and effective porosity of soil.

Table (4): Average of Loss in hydraulic head, drain discharge and entrance resistance of studied area during 5/2012 to 3/2014.

Parameter	2012			2013				2014		Average
	May	Aug	Nov	Jan	Apr	Jul	Oct	Jan	Mar	
Sub main drain No. 7										
h_e, m	0.330	0.420	0.366	0.473	0.497	0.461	0.526	0.569	0.593	0.471
Q m^3/day. m	0.056	0.051	0.061	0.075	0.071	0.046	0.068	0.073	0.064	0.063
r_e, day/m	5.900	8.204	6.032	6.316	6.990	9.924	7.706	7.795	9.199	7.563
Sub main drain No. 8										
h_e, m	0.324	0.433	0.330	0.364	0.382	0.383	0.410	0.474	0.506	0.401
Q m^3/day. m	0.063	0.058	0.065	0.073	0.072	0.057	0.067	0.075	0.072	0.067
r_e, day/m	5.178	7.488	5.069	4.978	5.307	6.711	6.126	6.303	6.986	6.016
Sub main drain No. 9										
h_e, m	0.446	0.613	0.425	0.434	0.447	0.440	0.449	0.482	0.498	0.470
Q m^3/day. m	0.072	0.068	0.075	0.080	0.082	0.068	0.075	0.082	0.080	0.076
r_e, day/m	6.187	9.025	5.688	5.424	5.483	6.446	6.023	5.855	6.195	6.258
Tile drainage system										
Average h_e, m	0.367	0.489	0.374	0.424	0.442	0.428	0.462	0.508	0.532	0.447
Average Q m^3/day. m	0.064	0.059	0.067	0.076	0.075	0.057	0.070	0.077	0.072	0.069
Average r_e, day/m	5.759	8.282	5.577	5.575	5.893	7.509	6.595	6.630	7.394	6.515

6. Depleted fraction (DF)

The drainage indicator is taken as the change of groundwater level (ΔWT). Figure (4) provides an example of the relationship between two indicators (DF and ΔWT). In this case it is hypothesized that decline or accretion of ground water is related to the depleted fraction. The obtained value of depleted fraction (DF) was ranging between 0.51 and 0.57 (table 5) which is considered normal for arid region. Bastiaanssen et al. 2001 indicated that the critical value of DF ranges between 0.5 and 0.7 for semi-arid and arid regions

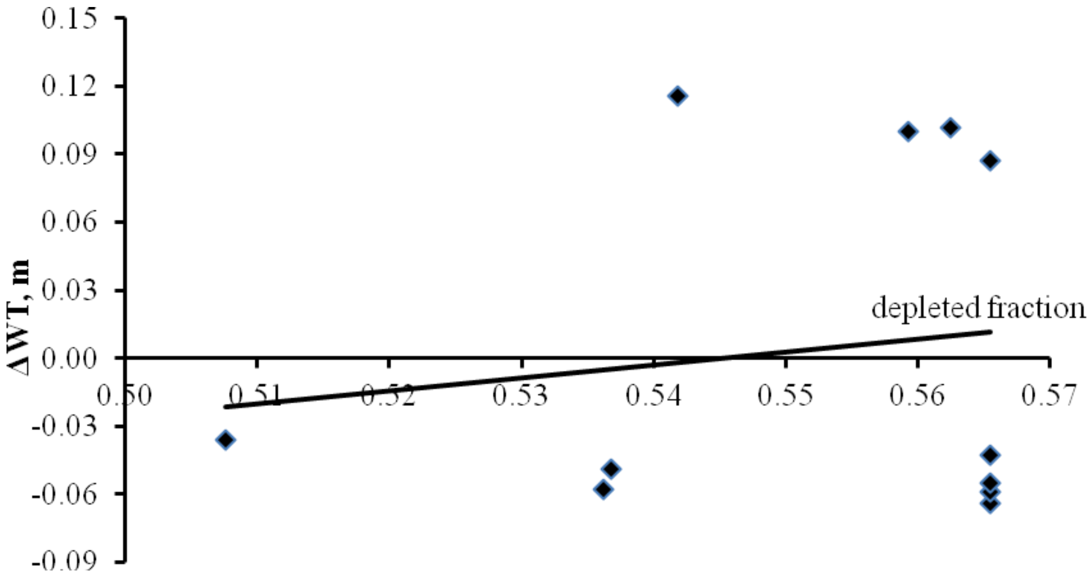

Fig. (4): Fluctuation of the ground water table (ΔW.T) as a function of monthly averages of the depleted fraction.

Table (5): the depleted fraction (DF) and change of ground water level (ΔWT) as a function of time

Month	ET_a	Pe	Vc	DF	WT	Δwt	
		mm/month				cm	m
Jan	44.15	8.90	78.07	0.51	37.50	-3.60	-0.04
Feb	51.72	5.00	91.45	0.54	41.10	-5.80	-0.06
Mar	76.19	5.90	134.74	0.54	46.90	11.60	0.12
Apr	101.30	2.00	179.14	0.56	35.30	10.00	0.10
May	135.97	0.00	240.45	0.57	25.30	-6.40	-0.06
Jun	142.03	0.00	251.15	0.57	31.70	-4.30	-0.04
Jul	135.18	0.00	239.04	0.57	36.00	8.70	0.09
Aug	124.33	0.00	219.86	0.57	27.30	-5.90	-0.06
Sep	104.64	0.00	185.04	0.57	33.20	-5.50	-0.06
Oct	103.88	1.00	183.70	0.56	38.70	10.20	0.10
Nov	52.83	5.00	93.41	0.54	28.50	-4.90	-0.05
Dec	42.79	5.90	75.67	0.52	33.40		

CONCLUSION

Improved subsurface drainage is necessary for most Egyptian soils to optimize the crop environment and reduce production risks. To assure an effective and profitable system, it's important to couple a good design process with the thorough evaluation of hydraulic parameters and environmental factors in studied area. In addition to the quality installation will ensure a drainage system that will perform effectively for many years to come. Hence, Five performance parameters cited in the literature by different authors were introduced in this study for the drainage system assessment. Namely; drainage intensity factor (α), days after cessation of recharge (t_A), water table draw down (WTDD), head loss fraction (h_{lf}) and entrance resistance (re).

All the results obtained by these performance parameters lead to an inefficient drainage system especially under sandy loam and loamy sand soils.

The overall average for (α) was low (0.026 day^{-1}), the average value for t_A was almost (18 days) which considered very high. The overall average for WTDD was very low (2.64 cm/day). The overall average for h_{lf} was very high (1.340) and more than the recommended value (0.6). the overall average for (r_e) was (6.515 day/m) which is much higher than the recommended value (2.25 d/m).

The results of this work might recommend studying the depleted fraction (DF) as a function of time to be used as a performance indicator in drainage assessment, and be related to the change of water table levels (ΔWT) as another influential performance indicator. DF = ETa/(Pe+Vc) Where: ETa is the actual evapotranspiration, Pe is the effective precipitation and Vc is the volume of surface water flowing into the study area. In other words, the plotting of indicator values (ΔWT) against another indicator or parameter (DF) that influences the value of the indicator is recommended.

This plotting shows the impact of the depleted fraction on the fluctuation of the water table. The results indicated that the indicator value of DF (obtained when the regressed trend line cuts the X-axis) was 0.55 which falls in the range of the critical value for arid and semi-arid regions.

The critical value of DF = 0.55 implies that if ETa at any month is less than 0.55 (Pe + Vc), a portion of this available water goes into storage, causing the water table to rise under inefficient drainage system.

REFERENCES

Abdel-Dayem, MS, Abdel-Gawad, S, and Fahmy, H. 2007. Drainage in Egypt: a story of determination, continuity and success. Irrigation and Drainage, 56, S101-S111. DOI: 10.1002/ird.335.

Boelter, D. H. and E. Gordon, (1974). Pipelines in forested wet lands; cross drainage needed to prevent timber damage. Jour. of Forestry, 72: 561-563.

Brouwer C., A. Goffeau and M. Heibloem (1985).Introduction to irrigation. FAO. Rome. Italy.

Cavelaars, J.C., Vlotman, W.F. and Spoor, G. 1994. Subsurface drainage systems. In: Drainage Principles and Applications. H.P. Ritzema (ed.). Publ. 16, 2nd ed. (completely revised), ILRI, Wageningen, The Netherlands, pp. 827-929.

Dieleman, P.J. and Trafford, B.D. (1976) Drainage testing. Irrigation and Drainage Paper No. 28, FAO, Rome

El-Hamchary, S. A. (1980). Studies of some hydrological aspects and soil properties under variables drainage designs. Ph.D. Thesis Dept. soil Fac. Agric. Al-Azhar Univ. ARE.

International Commission on Irrigation and Drainage. (2003). Important data of ICID member countries. Database on website: www.icid.org., International Commission on Irrigation and Drainage.

Katkevicius, L., L. Kincius., J. Zaltauskas. 2000. Evaluation of drainage technical condition. In: Transactions Water Management Engineering. Lithuanian University of Agriculture- Kaunas-Akademija, Lithuanian Institute of Water Management, Vilainiai, vol. 10, pp. 24, 39, 53 (in Lithuanian).

Molden, D. J., and Sakthivadivel, R. 1999. Water accounting to assess uses and productivity of water. *WaterResources Development* 155, Nos 1 and 2: 55-71.

Nijland, H.J. (Ed.), 2000. Drainage along the River Nile. RIZA Nota nr. 2000.052, Ministry of Public Works and Water Resources, Egypt, Ministry of Transport, Public Works and Water Management, Directorate-General of Public Works and Water Management, The Netherlands, 323 p.

Nijland, HJ, Croon, FW, and Ritzema, HP. 2005. Subsurface drainage practices: guidelines for the implementation, operation and maintenance of subsurface pipe drainage systems. ILRI Publication 60. Alterra, Wageningen University and Research Centre, Wageningen.

Ritzema H. (2014). Main Drainage Systems. MSc Programme Land and Water Development for Food Security. UNESCO-IHE.

Ritzema H. P. 2006. Subsurface flows to drains. In: H. P. Ritzema (Ed) Drainage Principles and Applications (pp. 283-294). ILRI Publ. 16, Wageningen, The Netherlands.

Stibinger J. (2005). Approximation of landfill drainage discharge by De Zeeuw-Hellinga model, and its verification on sanitary landfill of solid domestic waste. Plant Soil Environ. 51, (8): 335–342.

Stuyt L.C.P.M., W. Dierickx and J. Martínez Beltrán (2005). Materials for subsurface land drainage systems. FAO.

Stuyt, L.C.P.M., W. Dierickx., J. Martinez Beltran. 2000. Materials for Subsurface Land Drainage System FAO. Irrigation and Drainage Paper 60, Rome, 1983 pp.

Van Leeuwen, H.M. and Mohamed Ali, A. 1999. Criteria and Priority Ranking for Rehabilitation of Subsurface Drainage Systems. Proceedings ICID 17th Congress, Granada 1999.

Ven, G. A. 1983. Design of subsurface drainage systems in the Zuyderzee Project and in Egypt. January 1983, Technical Bulletin No. 11, Drainage Research Institute (DRI), Delta Barrages, Cairo, Egypt.

تقييم كفاءة نظام الصرف التحت السطحى فى منطقة البستان - مصر

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تعتبر عملية تحسين الصرف المغطى ضروريه لمعظم الأراضى المصرية لتحسين بيئة نمو المحاصيل وتقليل الفقد فى الإنتاج. لضمان وجود نظام فعال ومفيد، فإنه من المهم من الربط بين التصميم الجيد مع تقييم شامل من للخواص الهيدروليكية والعوامل البيئية في منطقة الدراسة. بالإضافة إلى جودة عملية تركيب نظام الصرف وضمان جودة نظام الصرف, ما من شأنه أن يجعل نظام الصرف يعمل بشكل فعال لسنوات عديدة قادمة. من اجل عملية التقييم, تم إدخال خمسة معايير لتقييم الأداء الخاص بنظام الصرف الزراعى وهي: معامل شدة الصرف (α)، زمن انحسار المياه بعد الري (t_A)، معدل هبوط الماء الارضى (WTDD)، نسبة الفقد نتيجة الاحتكاك ((h_{lf})) ومقاومة الدخول (re).

كل النتائج التي تم الحصول عليها من هذه المعايير تؤدي إلى نظام صرف غير فعال خصوصا في ظل الاراضى الرملية الطميية والرملية الطميية .

وكانت قيمة المتوسط العام لمعامل شدة الصرف منخفضة ($0.026\ day^{-1}$)، كان متوسط قيمة زمن انحسار المياه بعد الري (18 يوما) تقريبا والتي تعتبر مرتفعة جدا. وكان المتوسط العام لمعدل هبوط الماء الارضى منخفض جدا (2.64 سم / يوم). وكان المتوسط العام نسبة الفقد نتيجة الاحتكاك عالية جدا (1.340) وأكثر من القيمة الموصى بها (0.6). كان المتوسط العام لمقاومة الدخول (6.515 يوم / م) وهو أعلى بكثير من القيمة الموصى بها (2.25 يوم / م).

نتائج هذا العمل قد يوصي بدراسة نسبة الجزء المستهلك من الماء المضاف (DF) كدالة للوقت واستخدامها كمؤشر لتقييم أداء نظام الصرف الزراعى، وربطها مع التغير فى مستويات المياه الجوفية (ΔWT) كمؤشر أداء مؤثر آخر.

أظهرت هذه العلاقة ان قيمة نسبة الاستهلاك (تم الحصول عليها عندما يقطع خط الاتجاه تراجعت المحور X) كانت 0.55 والذي تقع في النطاق من القيمة الحرجة للمناطق الجافه وشبه الجافه. وهذه القيمه تعنى انه اذا زاد معدل الاستهلاك المائى عن 0.55 * (مجموع الماء المضاف والمطر الفعال) فان جزء من هذه المياه المضافه يذهب الى التخزين، مما يتسبب في ارتفاع منسوب المياه في الارتفاع في ظل نظام الصرف الزراعى الغير فعال.