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Improvement of Irrigation Efficiency by Developing Surface Irrigation System

[14]

Marwa AM Ibrahim[1]*, Mahmoud M Hegazi[2], Essam A Wasif[1], Osama MA Bedair[2]

1- Irrigation and Drainage Dept, Agric Eng Res Inst, Agric Res Center, 12619, Giza, Egypt

2- Agric. Engineering Dept, Fac of Agric, Ain Shams Univ, P.O. Box 68, Hadayek Shoubra, 11241, Cairo, Egypt

*Corresponding author: marwaabdelnaby@agr.asu.edu.eg

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Abstract

The experiments were Carried out in Biahmu Village at Al-Fayoum Governorate, Egypt during the two winter seasons of 2018/2019 and 2019/2020, on wheat crop to (cv. Gemmiza 11) evaluate the traditional surface irrigation system "TSIS" and the improved surface irrigation system "ISIS"(terrace), under laser leveling with two slops (S1 ≈ zero% and S2 ≈ 3%). The evaluation parameters included; reduction in land loss "LL", the roughness coefficient of marwa-walls, water efficiencies (i.e., water conveyance efficiencies "WCE", water application efficiencies "WAE" and water storage efficiencies "WSE"), yield productivity "Yp", total applied water and water required, irrigation water productivity "IWP" and times of water advance, recession and opportunity. The results concluded that improving traditional marwa, led to reduction in land loss by 49.46% from the area of marwa, and "WCE" increased by 83.17% in improved Marwa "IM" the compare to Traditional Marwa "TM. It was observed that on the efficiency of water added to the field irrigated by "TM". The highest level of water productivity ($1.79 kg_{wheat}/m^3_{water}$) was achieved in "IM" at a level of 3%. Advanced time "T.Adv" (min) decreased at 50, 50.77, 27.6, 20.75, and 17.17% and 30.9, 40.51, 22.8, 10.89 and7.05% for "TL and IL" by sloping to "S2".

Keywords: Surface irrigation terraces, Improvement, Conveyance efficiency, Wheat crop.

1 Introduction

Irrigation is a common method of water that is distributed and applied along the soil surface by gravity. This method looks very simple, but the movement of water on top of the field and distribution is a very complex process due to spatial and temporal variations in soil.

Surface irrigation is the oldest method of Egypt is Surface irrigation and most widely used. Where, the low efficiencies in surface irrigation are not deep-seated to the method but are due to pauper design and management.

Irrigation water consumes about 80 % of the water budget for cultivating. The future will require even greater improvements as competition for limited water supplies continues to increase. Now the saving of irrigation water is considered a strategic target in Egypt. The work plan was done at (2011-2021) to save water for reclaiming the targeted areas in the 2030 strategic plan, (El-Gindy 2011).

Some of the most important palpably benefit resulting from surface irrigation system (improved irrigation canals) those, that can be evaluated with some accuracy are water-saving that would otherwise be lost through seep, reclamation of waterlogged lands, lower maintenance, economies of canal improved operational cost, reducing irrigation time ranged from 50 to 60% raise water efficiency and increase in crop yields ranges from 9 to 20% depending on the type of crop. Besides, there is about 1 % of the total command area has been saved and made available for agriculture (40%) and roads (60%), (Ashour et al 2010, Sahu et al 2014).

Reported that improved is a long term effective technique for reducing seepage losses from watercourses, in addition to the improvement, provides a smooth surface, the abrasion coefficient decreases as the impedance to flow decreases and hence the velocity of flow increases, (Javaid et al 2012).

Experimented and evaluated the water conveyance efficiency "WCE" of improved watercourses. The results revealed that the "WCE" of watercourses increased by 8 to 30%. The cropping intensity has also increased by about 29 % in Spring and 12 % in Autumn seasons, (Mangrio et al 2016).

Mentioned that by improving surface irrigation system "ISIS" from traditional to the lining, both of "WCE" and "WAE" were increased from 82.4 to 92.7% and 59 to 81.5%, As well wheat and sorghum productivity were increased by 10.81 and 10.44%, respectively. Also, "WUE" for wheat and sorghum were 1.49 and 1.08 kg $m^{-3,}$ respectively at "ISIS" compared with 0.87 and 0.631 kg m^{-3} under traditional surface irrigation system "TSIS". On the other hand, irrigation time decreased about 31.39% using "ISIS", (El-Nakib et al 2012, Saad Eddin et al 2016).

The variable slope of land leveling (laser) led to high efficiency in the irrigation and water distribution system and increase productivity (Reena et al 2017, Amaresh et al 2018, Deshmuk et al 2019 and Juan et al 2020).

On the other hand, the highest results for "WUE" and "YP" 1.78 $kg.m^{-3}$ and 3.23Mg fed^{-1}, respectively were on record at 0.05% slope, (El-Khatib 2010; El-Khatib and El-kady 2010). In addition, (El-Khatib et al 2014) concluded that all parameters for faba bean, i.e., modulation (size, mass, and number.), growth (shoot biomass), yield (biological yield, seed yield, and seed index), and "WUE" had a direct proportion with leveling slope.

Otherwise, the precision land leveling for rice crops, saved about 44.68% of total applied irrigation water for 3% slopes, comparing with the traditional leveling, and produced 3.96 Mg rice $grain.fed^{-1}$ and used 1.0 m^3 irrigate water to produce 0.39 kg of rice grains, (Bahnas 2008). Delivery systems for surface irrigation farms convey water from the farm water source to fields in open canals (James 1988).

The main objective of this study is to evaluate and compare the different efficiencies of applied improved open channel delivery systems as lined and unlined ditches (traditional marwa) delivery systems for surface irrigation farmers.

2 Materials and Methods

Field experiments were carried out in Biahmu village at Al-Fayoum Governorate, Egypt. The measurement was carried on the point of Al-Falih channel with line of 29.38° 45' 36" latitude and longitude line of 30.85° 06' 16" in Senouras area during two winter seasons of 2018/2019 and 2019/2020.

To achieve the research aim, the studied variables included two surface irrigation forms of (Traditional Marwa "TM" (Change unlined Marwa) and improved Marwa "IM" (Change lined Marwa)) under two soil leveling slopes "S"; zero leveling "S1", and laser leveling at 3% "S2". Where, Marwa received irrigation water directly from the branch channel (Mesqa) to convey irrigation water to the field by gravity **Table 1**. The study sets were selected as follows:

* Traditional Marwa in three positions with lengths of 84, 157 and 180 m serving 4.5, 6.9 and 6.3 fed, respectively, as shown in **Fig 1.**

* Improved Marwa in three "IM" with lengths of 84, 157 and 180 m serving 6, 8, and 9 fed, respectively as shown in **Fig 1**. Improved Marwa "IM" is a channel over the ground with a U-section shape with dimensions of 84×60 cm. It has an iron gate with 60×50cm in dimensions.

Table 1. Studied variables table

TM1	TM2	TM3
IM4	IM5	IM6
TL1	TL2	TL3
IL4	IL5	IL6
S1	S2	

TM1 to TM3: Traditional marwa
IM4 to IM6: Improved marwa
TL1 to TL3: Traditional land
IL4 to IL6: Improved land
S1: Laser leveling slop zero %
S2: Laser leveling slop 3 %

The water source was the Nile River from Abrahamic Canal- Youssef Bahr- Senoures Bahr- Biahmu Bahr. Applied water was controlled by controlling irrigation time. The stream of irrigation was cut off at 90% of the irrigation run (as a traditional practice) (El-Khatib and El-Kady 2010). The main water quality parameters were analyzed in Central Lab., Faculty of Agriculture, Ain Shams Univ., and presented in **Table 2**.

Soil analysis was performed in the Central Lab; Fac. of Agric. Ain Shams University. Soil samples were obtained along the plot of 20 m in each pilot plot, with the help of the auger, taken from depths of 0-30 and 30-60 cm. Soil textural, physical and hydro-physical analysis of the soil were determined and described in **Tables 3 and 4.**

Wheat seeds (cv. Gemmiza 11) were planted as winter crop at 15 Nov., and harvested 15 May; on the 1st and 2nd season, respectively. Commonly planting method known as Herati on ridges was used in planting. Wheat received five irrigations as recommended by crop planting researchers (as surface irrigation system in old land). All agricultural practices, i.e., fertilizing, hoeing, weeding and sprays against insects, pests and diseases were followed throughout the growing seasons as recommended for conventional wheat planting by Ministry of Agriculture and Land Reclamation.

To evaluate the studied parameters, the following measurements were determined: land losses "LL" (%), frication coefficient of walls Marwa "F" water efficiencies, (conveys, application, and storage), yield productivity (kg fed^{-1}), total applied water (m^3 fed^{-1}) and water required, irrigation water productivity (m^3 kg^{-1}), and advance, recession and opportunity times (min). Experiment was designed by strip plot design with three replicates, as shown in **Fig 1.**

2.1 Measurements and calculations

2.1.1 The land losses

Land losses "LL" (%), for "TM and IM", for six different zones were surveyed. The total area of each zone was determined by GPS-MAP device. Marwa length and width were measured by Linen scale tape. To calculate the "LL" the following equation was used (Reported by Osman 2016).

$$LL = \frac{L \times W}{A} \times 100 \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where:
L: Marwa length, m,
W: Average Marwa width, m, see **Figs 2 A and B**
A: Total zone area, m²

2.1.2 Marwa roughness coefficient (Manning), (El-Gindy 2007)

$$n = \frac{1}{V} R^{0.67}.S^{\ 0.5} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where:
n: Roughness modulus,
R: Hydraulic radius, m ($= \frac{A}{P}$),
A: Marwa area, m^2,
P: wetted perimeter, m
S: Slope, mm^{-1}.
$v = K \times v_s$
k: Correction factor (≈ 0.66 according to, (James 1988).
v_s: Surface velocity, m sec^{-1}, ($= \frac{Travel\ distance\ (m)}{Travel\ time\ (s)}$), see **Fig 3**.

Table 2. Water quality parameters

pH	EC (dSm^{-1})	Na^+ (meq l^{-1})	K+ (meq l^{-1})	Ca^{+2} (meq l^{-1})
6.90	0.41	1.50	0.24	2.00
Mg^{+2} (meql^{-1})	**Cl^- (meq l^{-1})**	**HCO_3-(meql^{-1})**	**SO_4^{-2} (meql^{-1})**	
0.50	2.40	1.30	0.54	

Table 3. Soil textural and physical properties, at the experimental field

Depth (cm)	Particle size distribution, %				Physical properties		
	Sand (%)	Silt (%)	Clay (%)	Textural class	PH	EC (dSm^{-1})	ρ (gcm^{-3})
0-30	39.9	25.6	34.5	Clay loam	7.8	3.2	1.43
30-60	9.9	36.7	53.4	Clay	8	1.7	1.24

Table 4. Hydro-physical properties, at the experimental field

Depth (cm)	FC (%)	PWP (%)	Sat (%)	AW (%)	Hydraulic. cond. (mmh^{-1})
0-30	34.36	21.65	46.21	12.71	4.07
30-60	43.36	31.36	53.49	12	2.43

2.1.3 Water efficiencies

2.1.3.1 Water conveyance efficiency

The water conveyance efficiency "WCE" (%) was computed with the adoption of the following formula, (James 1988).

$$\mathrm{WCE} = \frac{Q_{out}}{Q_{in}} \times 100 \ldots\ldots\ldots\ldots\ldots (3)$$

Where:
Q_{out}: Water discharge delivered to irrigation plot by Marwa, $m^3\ h^{-1}$,
Q_{in}: Water discharge delivered from the source, m^3h^{-1}

$$Q = A \times v$$

Where:
A: is the cross-section area (m^2).
v: is the average velocity of flow (m/sec).

2.1.3.2 Water application efficiency

Generally, water application eff., "WAE" (%) was estimated by using the following equation, (Michael 2008).\

$$\mathrm{WAE} = \frac{W_S}{W_F} \times 100 \ldots\ldots\ldots\ldots\ldots (4)$$

Where:
W_s: Depth of stored water in the root zone, during the irrigation process (cm). Hence, "W_s" was calculated according to the following equation (Liven and Rooyen 1979).

$$W_S = \frac{(SM_2 - SM_1)}{100} \times A_S \times D_i \ldots\ldots (5)$$

SM_2: Soil moisture content as mass, 48 h after an irrigation, %,
SM_1: Soil moisture content as mass, before irrigation, %,
As: Soil specific weight (ρs /ρw) dimensionless,
ρ_s: Soil bulk density, g cm^{-3},
ρ_w: Water density, g cm^{-3},
D_i: Root depth, cm, (Assuming ≈30cm),
W_f: Depth of applied water to the field (cm). Hence, "W_f" was calculated according to the following equation:

$$W_F = \frac{V}{a} \times 100 \ldots\ldots (6)$$

V: Average total value of applied water on the field, m^3,

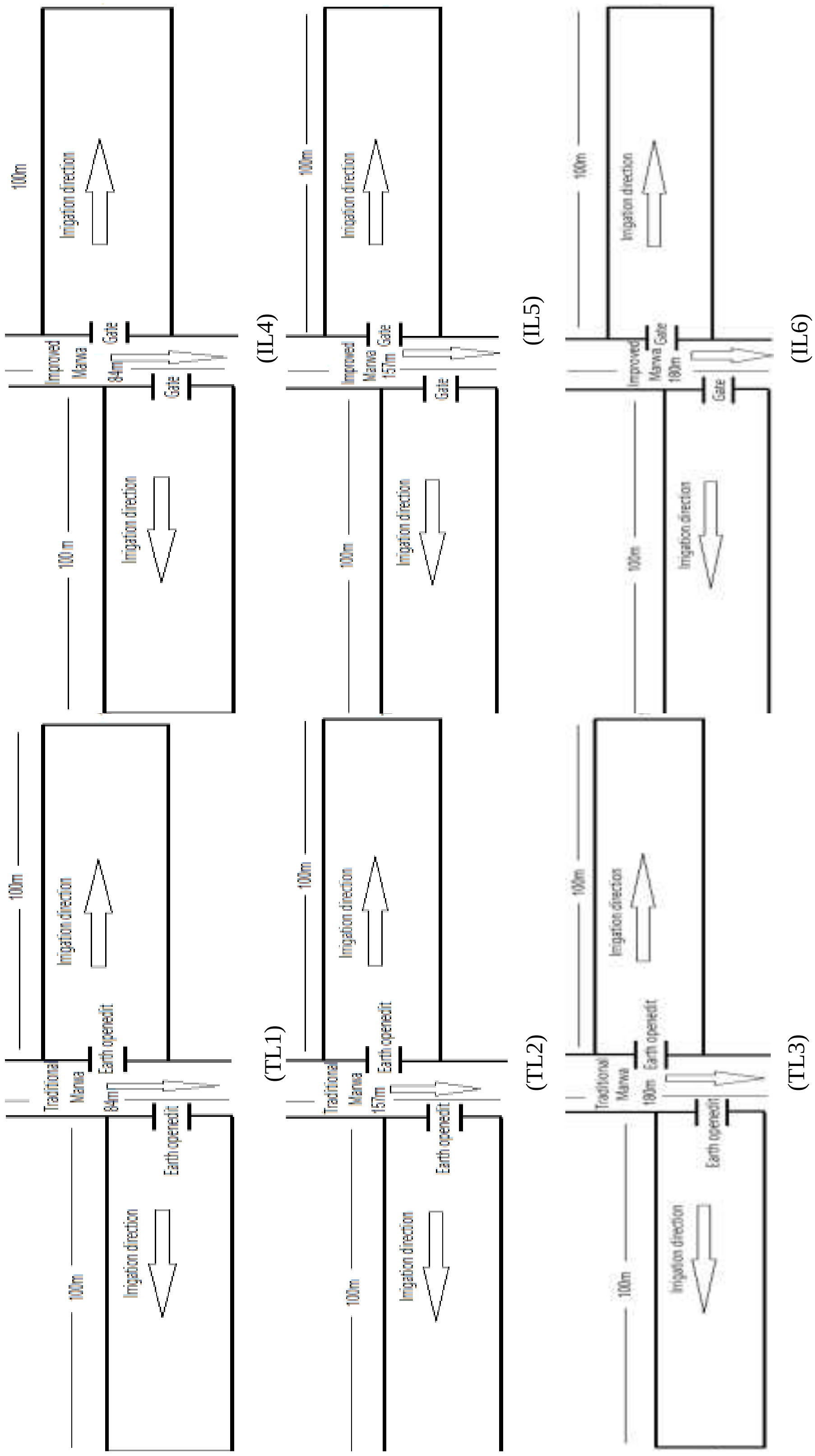
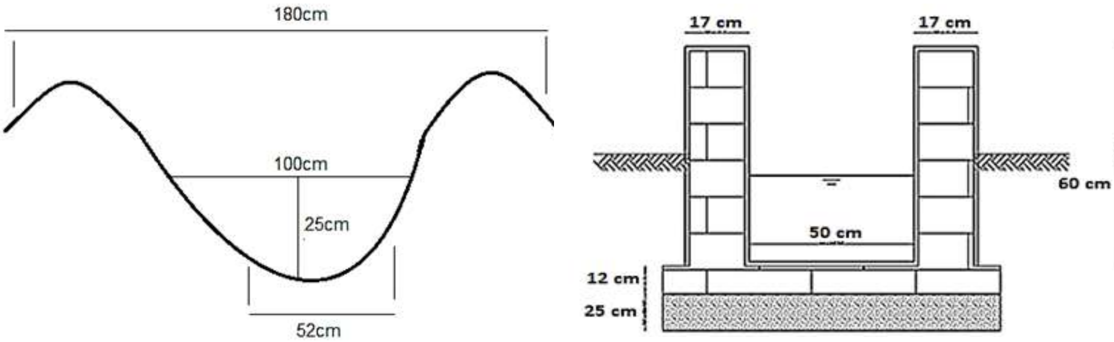


Fig 1. Layout of the experiment Traditional and Improved lands area



(A) Traditional Marwa (Change unlined Marwa) (B) Improved Marwa (Change lined Marwa)

Fig 2. The cross-section in a Traditional and Improved Marwa

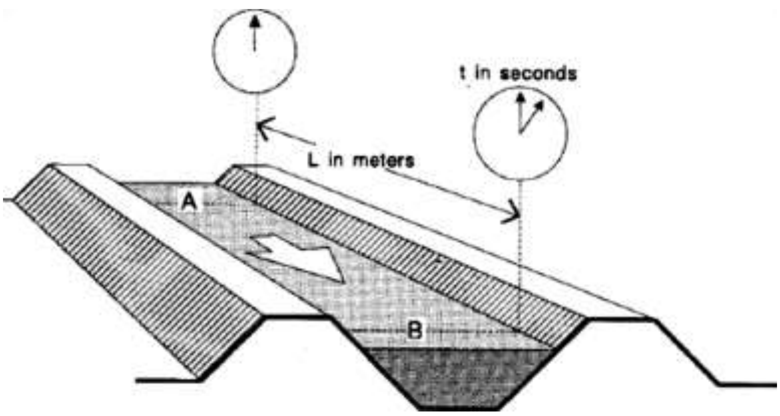


Fig 3. Surface velocity measurement by float method

$$V = Q_{out} \times T$$

T: irrigation time, h fed^{-1}.
a: Irrigation cross section area for plot, m^2

2.1.3.3 Water storage efficiency

Water storage eff., "WSE"(%) was given by equation: (Jurriens et al 2001).

$$WSE = \frac{W_S}{W_n} \times 100 \text{ ………..…….. (7)}$$

Where:
W_n: The depth of water that needs to be stored in the root zone, cm. Hence, "W_n" was calculated according to the following equation, (Allen et al 1998).

$$W_n = \frac{\Theta F_c - SM_1}{100} \times A_S \times D_i \text{…………..… (8)}$$

ΘF_c : Soil moisture content at field capacity in mass (%) see **Tables (2 and 3)**

2.1.4 Yield productivity

For each planted area the wheat yield were harvested and the seeds production were recorded as kg fed^{-1}.

2.1.4.1 Total applied water and water requirement

Wheat plants received 5 irrigations during the season. Each irrigation time was recorded by digital stopwatch. Meanwhile, water velocity was determined by float method. The total applied water ($m^3.fed^{-1}$) was calculated with the following equation:

$$TAW = N \times T \times A \times v_s \ldots\ldots\ldots.. (9)$$

Where:
TAW: Total applied water, ($m^3.fed^{-1}$),
N: Irrigation No. dimensionless,
A: Marwa cross section, m^2,
v_s: Water velocity, m h^{-1}.

Meanwhile, the water requirement "TCWR" (m^3 fed^{-1} season) was calculated according the equation (10) as seen below, (Brouwer and Heibloem 1987).

$$TCWR= d_n \times 4.2 \times ET_o \times K_c \ldots\ldots\ldots.. (10)$$

Where:
d_n: Number of days. in period stage, (day),
4.2: Conversation factor,
ET_o: Reference crop evapotranspiration, mm.day^{-1}, and,
K_c: Crop coefficient, dimensionless **Table 5**.

2.1.4.2 Irrigation water productivity

The irrigation water productivity was estimated according the following formula, (Hussein et al 2019).

$$IWP = \frac{E_Y}{TAW} \ldots\ldots\ldots\ldots\ldots..\ldots (11)$$

Where:
IWP: Irrigation water productivity, ($m^3.fed^{-1}$).
Ey: Economical yield, kg fed^{-1}.

3 Results and Discussion

3.1 Land losses and saved area

The data recorded in **Table 6** cleared that the average land losses "LL" (%) at "TM" occupied was 0.93% from the total area. As well, at "IM", "LL" occupied was 0.39% from the total area. In case improving traditional Marwa, the average of "LL" was reduced from 0.93 to 0.47% with reduction about 49.46% of traditional Marwa area. So, it could be concluded that improving Marwa, led to an increase in the cultivated 58% area, and consequently, increasing the yield 15.3% under zero leveling slop "S1" and 20.5% under leveling slop 3% "S2".

3.2 Relation between roughness coefficient and water surface velocity

Figs 4 Should the relation between roughness coefficient of Marwa and the water velocity. Generally, if the roughness coefficient of Marwa walls increased (due to uneven walls, weed and non-maintenance) the water velocity decreased. Therefore, at TM the range of roughness coefficient was 0.59 to 0.9, resulting in decreased water velocity from 0.18 to 0.10 m sec^{-1}. On the other side, the corresponding data at IM the range of roughness coefficient was 0.165 to 0.196 when the water velocity decreased from 0.28 to 0.23 m sec^{-1}. The results from the previous figure illustrated that, the coefficient of roughness at the TM increased by 75.23% and the water velocity decreased by 44.26% compared with "IM". The results were logic where the TM has uneven walls but the IM has a smooth wall.

The results for the relation between surface velocity of water "v_s" and roughness coefficient "n" were fitted to the equations as shown in **Fig 4.**

It can be noted from the previously explained equations that, roughness coefficient "n" had an inverse relation with water velocity "v". Whereas an increase the "n" led to slowdown of the water velocity into the water way, in "IM", "n" had a linear relation with water velocity at correlation of determination of 0.9589. Meanwhile, the relation differed in the case of the "TM", where "n" had a linear relation with "v" at correlation of determination of 0.9619.

3.3 Water conveyance efficiency

Loss of water conveyance, at traditional Marwa "TM", mainly consisting of permeability from the sides and deep seepage into the soil. It mainly relies on the canals length and conditions and soil type. As shown in **Fig 5**, the water conveyance efficiency was 54.7, 47.3 and 41.6% at "TM" and it was 92.8, 89.1 and 83.5% at "IM" at lengths Marwa 84,157, and 180m, respectively. Generally, it could be

Table 5. The average K_c for wheat crop per month, (Allen et al 1998).

Months	**Nov (15-30)**	**Dec (1-30)**	**January (1-31)**	**February (1-28)**	**March (1-31)**	**April (1-30)**
K_c	0.49	0.78	1.1	1.15	1.11	0.68

Table 6. Land losses and saved area for "TM and IM"

Marwa type	**Avg. service area (fed)**	**length (m)**	**Avg. width (m)**	**Avg. Marwa area, (m^2)**	**LL (%)**
"TM"	4.5	84	1.80	151.2	0.80
	6.9	157	1.70	266.9	0.92
	6.3	180	1.58	284.4	1.07
Avg.	5.9	140.33	1.69	234.17	0.93
In case improving traditional marwa	4.5	84	0.84	70.56	0.37
	6.9	157		131.88	0.46
	6.3	180		151.2	0.57
Avg.	5.9	140.33	0.84	117.88	0.47
"IM"	6	84	0.84	70.65	0.28
	6.5	157		131.88	0.48
	9	180		151.2	0.4
Avg.	7.16	140.33	0.84	118.01	0.39

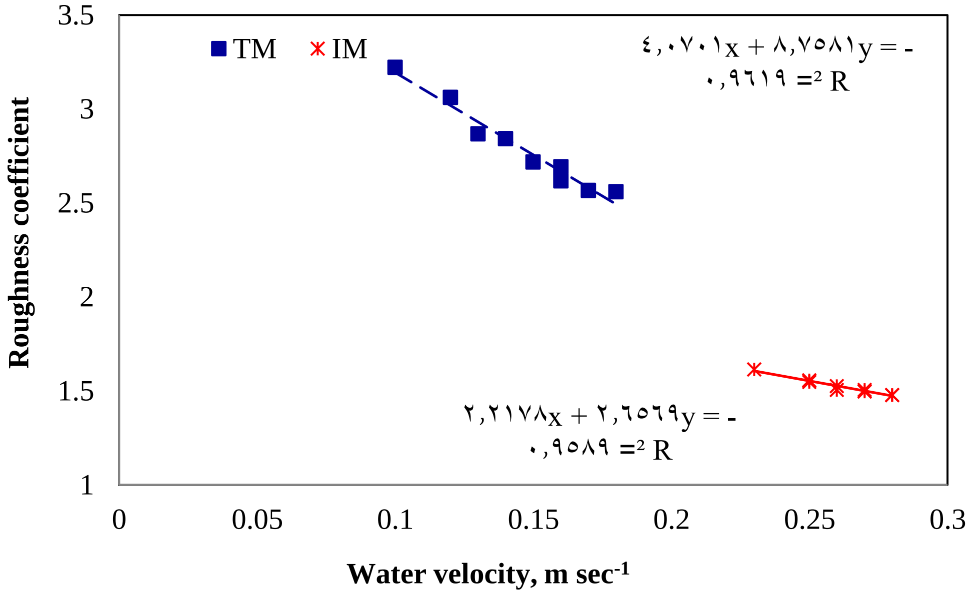


Fig 4. Effect of roughness coefficient of Marwa wall on water velocity at different Marwa types

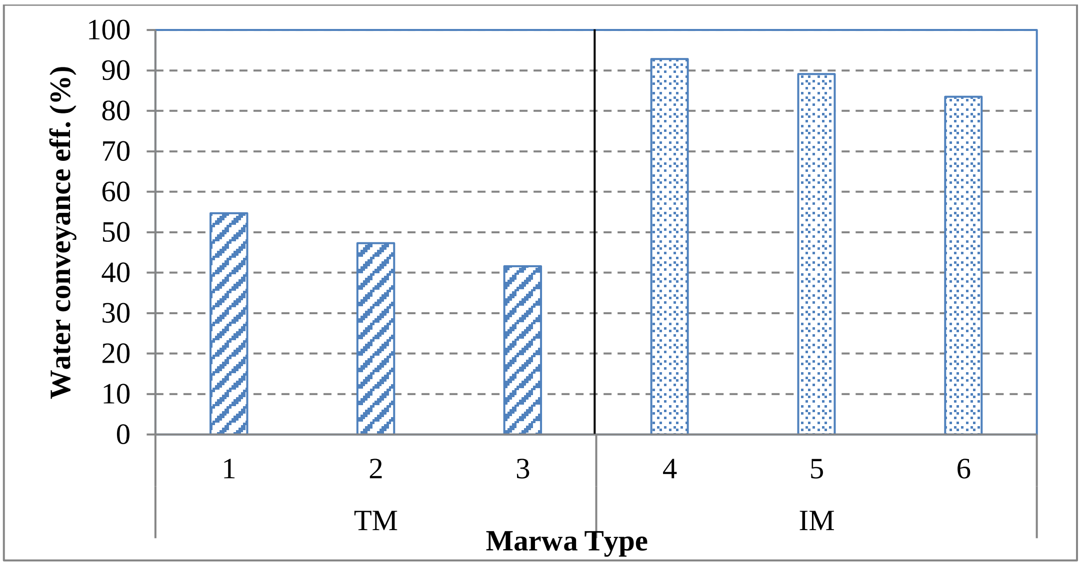


Fig 5. Water conveyance efficiency for different Marwa types

noticed that "WCE" was affected hardly by improving Marwa, where, the increasing rate on the average of "WCE" for improving Marwa was about 83.17% compared with "TM".

3.4 Water application and storage efficiencies

Fig 6 Should that both the outlines the date of "WAE" and "WSE", for traditional land "TL" and improved land "IL" under "S1" and "S2". "WAE" (%) was a general indicator of the irrigation system performance. It is affected by the laser land leveling. Where, it can be realized that leveling slope had more effected on "TL" compared with improving Marwa. Hence, with 3% leveling slope "WAE" was increased by 36.27 and 7.95%, respectively at "TL and "IL". In addition, both of improving Marwa and leveling "S" had slight effect on "WSE".

3.5 Applied water, yield, and irrigation water productivity

In laser leveling at "S1" (0%) the applied irrigation water was about 2516 and 1936 m^3 fed^{-1} at "TL and IL", respectively. Meanwhile, it was decreased due to using laser leveling at "S2" (3%) to 1865 and 1474 m^3 fed^{-1}, about (25.91 and 23.82%), respectively at "TL and IL". Also, the applied water by "ISIS" was decreased by 23.13 and 20.97%, respectively at "S1 and S2" from the “TSIS” as shown in **Fig 7** and **Table 6**.

The grain yields ($kg.fed^{-1}$) for wheat crop obtained for the "TL and IL" were presented in **Table 7**. the yield productivity "Yp" was affected by improving surface irrigation system "ISIS". Where, the yield was high in "IL" about 2250 and 2640 kg fed^{-1} compared with "TL" about 1950 and 2190 kg fed^{-1}, respectively at S1 and S2. On the other hand, "S" treatments lead to an increase in wheat yield with 12.31 and 17.34% at "TL and "IL" respectively.

According to the results in **Table 8** and concerning, "IWP" data presented in **Fig 8,** it could be concluded that under "IL and S2" the yield was higher and applied water was less compared with "TL and S1". Consequently, "IWP" become higher under "IL and S2" than "TL and S2". Where, "ISIS" led to an increase in "IWP" from 0.78 to 1.17 and 1.16 to 1.79 kg m^{-3} for S1 and S2, respectively. Meanwhile, increasing "S" from "S1" to "S2" tended to increase "IWP" by 51.51 and 54.1% at "TL" and "IL". The max value of "IWP" was 1.79 kgm^{-3} recorded at IL and S2 treatment.

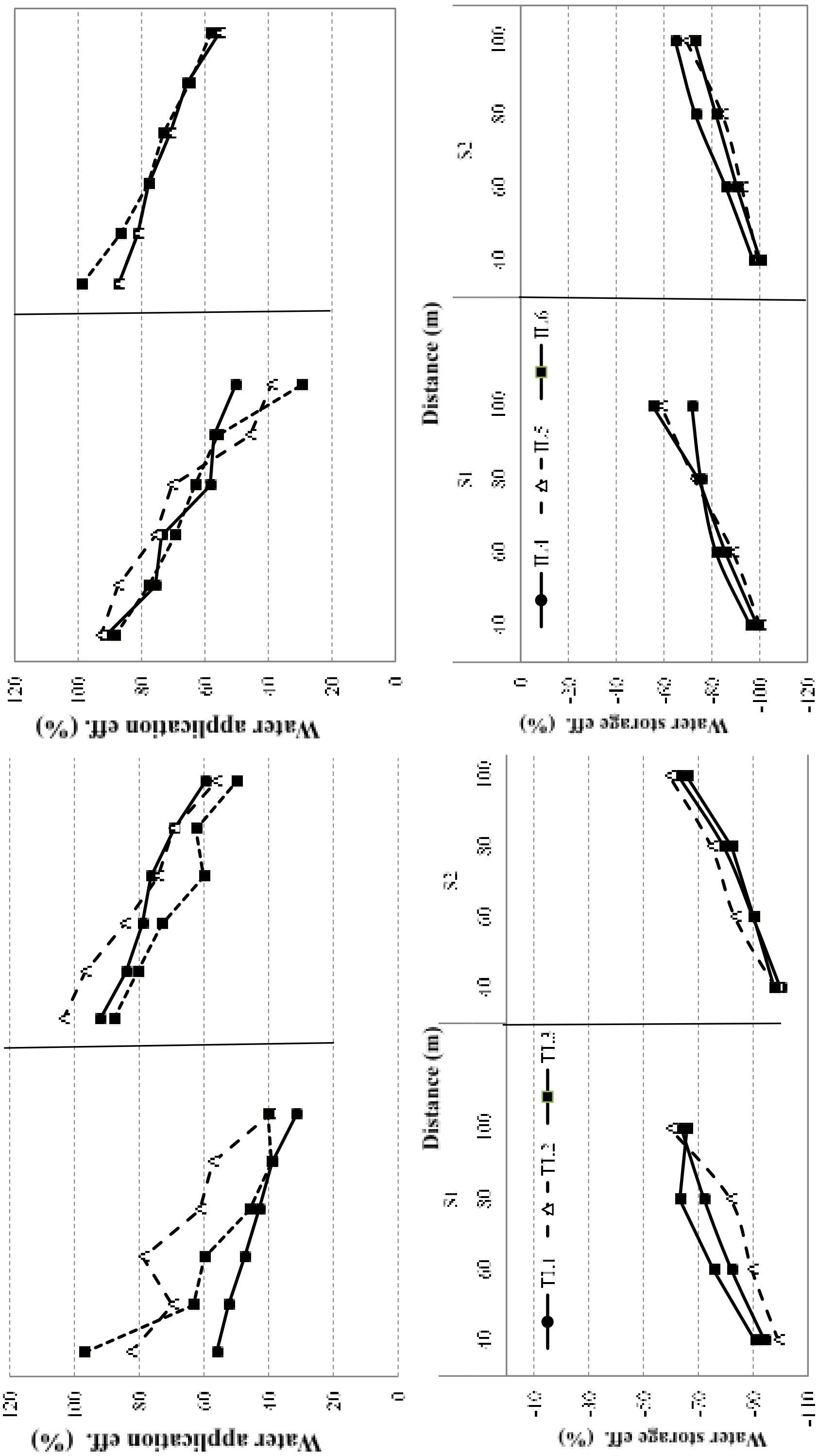


Fig 6. Water efficiencies (WAE and WSE) for land treatment along 100m through field

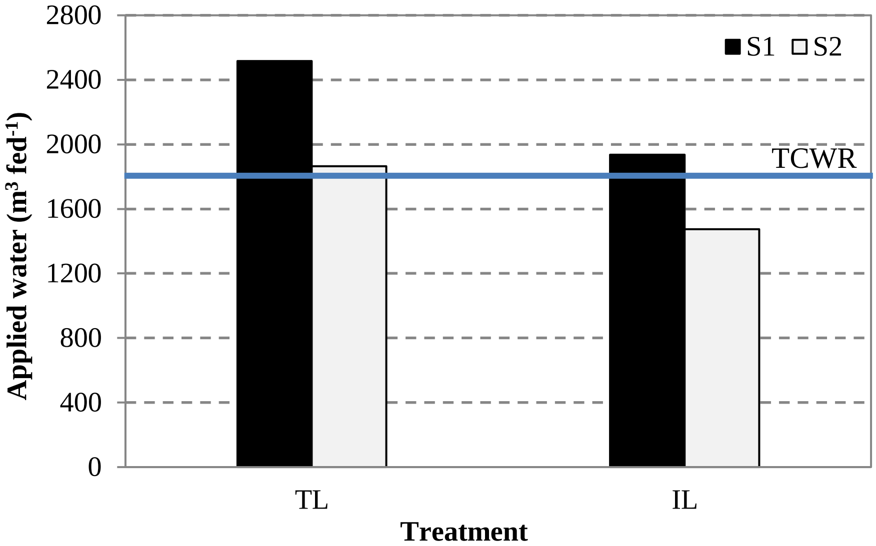


Fig 7. Relation between water and land trend

Table 7. The average "TAW" (m^3 fed^{-1}) through five irrigations for "TL" and "IL" under different leveling slops (S1 and S2) for the wheat crop

Marwa type		Traditional Marwa "TM"						Improving Marwa "IM"					
Leveling slope		**S1**			**S2**			**S1**			**S2**		
		TL1	**TL2**	**TL3**	**TL1**	**TL2**	**TL3**	**IL4**	**IL5**	**IL6**	**IL4**	**IL5**	**IL6**
Irrigation No.	1	525	548	535	385	413	416	406	392	412	304	325	311
	2	519	520	508	393	397	350	372	381	379	296	313	298
	3	500	493	507	336	347	361	380	385	391	280	232	278
	4	490	483	493	367	337	365	401	399	373	296	278	290
	5	482	473	473	383	370	376	377	379	381	297	325	299
TAW $m^3 fed^{-1}$		2516	2517	2516	1864	1864	1868	1936	1936	1936	1473	1473	1476

Table 8. Effect of ISIS and S, on wheat yield and applied water

Land type	**Replicate**	**Yield (kg fed^{-1})**		**Irrigation water productivity (kg m^3)**	
		S1	**S2**	**S1**	**S2**
TL	1	1990.7	2190.7	0.79	1.17
	2	1931.2	2191.0	0.76	1.17
	3	1928.1	2188.4	0.76	1.17
	Avg.	1950	2190	0.77	1.17
IL	4	2246.9	2641.0	1.16	1.79
	5	2251.4	2638.5	1.16	1.79
	6	2251.7	2640.6	1.16	1.78
	Avg.	2250	2640	1.16	1.79

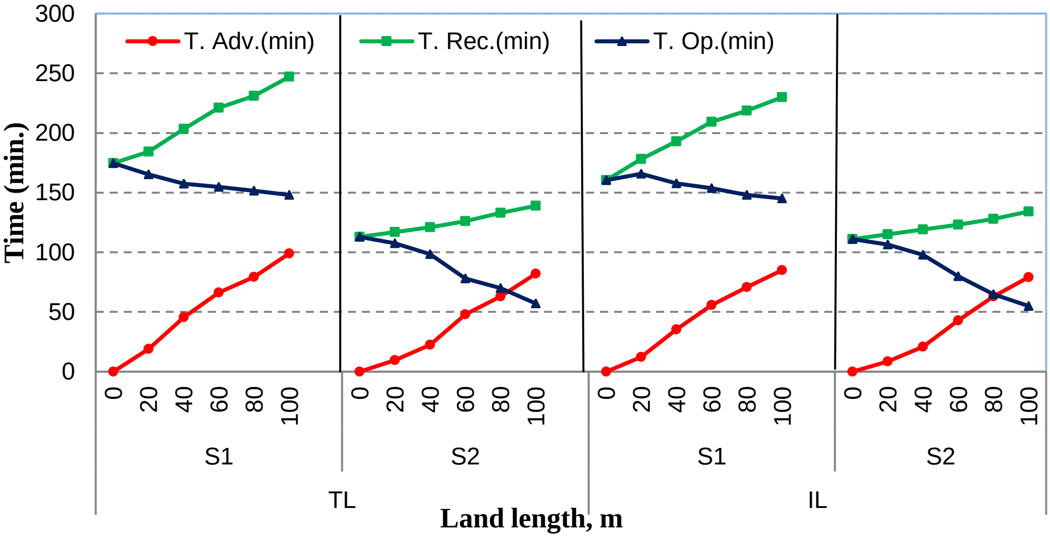


Fig 8. Effect of land treatment on water advance, recession and opportunity times.

3.6 Times of water advance, recession and opportunity time

Fig 8 Illustrated that advanced time "T. Adv" (min) decreased at the each land at 20, 40, 60, 80 m far from Marwa of (50.00, 50.77, 27.6, 20.75 and 17.17%) and (30.90, 40.51, 22.80, 10.89 and 7.05%) for "TL and IL" by sloping to "S2".

Meanwhile, recession time "T.Rec" (min) was fitted to the following equations:

For S1:

At TL $y \approx 0.7419x + 173.12$ ($R^2 = 0.99$)

At IL $y \approx 0.6956x + 163.44$ ($R^2 = 0.98$)

For S2:

At TL $y \approx 0.2614x + 111.76$ ($R^2 = 0.98$)

At IL $y \approx 0.2257x + 110.38$ ($R^2 = 0.99$)

Where: y: axis expressed as recession time (min.),

x: axis expressed as land length (m).

4 CONCLUSIONS

In case of improving traditional Marwa, the avg. "LL" was reduced (≈ added area) about 50.39% of Marwa area. The "WCE" was affected hardly by improving Marwa, where, the increasing rate on average "WCE" reached to 83.17% compared with "TM". Leveling slope had more effect on "WAE" compared with improving the Marwa. In addition, both of improving Marwa and leveling "S" had no or slightly effect on "WSE". Improving Marwa and increasing slope, had a direct and indirect proportion with crop productivity and applied water. The max value of irrigation water productivity "IWP" 1.79kg m^{-3} was obtained at improved land with slop leveling 3% "IL & S2" treatment. Advanced time "T.Adv" (min) decreased at 50, 50.77, 27.6, 20.75, and 17.17% and 30.9, 40.51, 22.8, 10.89 and7.05% for "TL and IL" by sloping to "S2". Meanwhile, recession time "T. Rec" (min) was fitted to the following eqs:

$y \approx 0.7419x + 173.12 \approx 0.6956x + 163.44$,

$y \approx 0.2614x + 111.76 \approx 0.2257x + 110.38$.

Where y: axis expressed as recession time (min.),

x: axis expressed as land length (m).

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تحسين كفاءة الري بتطوير نظام الري السطحى

[14]

مروة عبد النبى محمد ابراهيم[1]* – محمود محمد حجازى[2] – عصام الدين عبد المنعم واصف[1] – أسامة محمد أحمد بدير[2]

1- قسم الرى والصرف – معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – 12619 – الجيزه – مصر
2- قسم الهندسة الزراعية – كلية الزراعة – جامعة عين شمس – ص.ب 68 – حدائق شبرا 11241 – القاهرة – مصر

*Corresponding author: marwaabdelnaby@agr.asu.edu.eg

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الموجـــــــز

أجريت هذه الدراسة في منطقة بياهمو التابعة لمحافظة الفيوم خلال موسمين شتويين متتالين (2019/2018) ، (2020/2019) بزراعة محصول القمح بغرض تقييم أداء المراوى الترابية (التقليدية) ومقارنتها بأداء المراوى المطورة (المبطنة)، من خلال اخذ القياسات التالية: نسبة الفقد في الأرض، معامل الخشونة لجدران المروى، كفاءات الري (النقل، الإضافة، والتخزين)، انتاجية المحصول، كمية المياه المضافة والإحتياجات المائية، إنتاجية وحدة مياه الري المستخدمة. وتم إختيار منطقتين على جانبى ترعة بياهمو الرئيسية. المنطقة الاولى وتضم ثلاث مراوى تقليدية (ترابية) تستمد مياهها من الترعة الاصلية كانت اطوال هذه القنوات 84، 157 ، 180م تخدم مساحات4.5، 6.9، 6.3 فدان على التوالى. أما المنطقه الثانيه فكانت تضم ثلاث مراوي تم تطويرها بالتبطين ذات اطوال 84، 157، 180م تخدم مساحات 6 ، 8، 9 فدان على التوالى. وفي الموسم الأول تمت تسوية الارض بالليزر عند ميول صفر بينما في الموسم الثانى تم استخدام التسوية بالليزر عند ميول 3% . واوضحت النتائج ان تطوير نظام نقل المياه فى المراوى المبطنة أدى إلي تقليل نسبة الارض المفقوده، ونقص نسبة الارض المفقودة بحوالى 49.46%. كما أظهرت النتائج ان كفاءة نقل المياه وصلت الى 83.17% في المراوى المطورة مقارنه بالمراوى التقليدية. أما التأثير الواضح لمنسوب التسوية لوحظ على كفاءة اضافة المياه للحقل في الأراضى ذات المراوى الترابية. كما تحققت اكبر قيمه من انتاجية وحدة المياه (1.79 كجم م$^{-3}$) في الاراضي التى تم تطوير نظام نقل المياه بها (المراوى المبطنة) عند منسوب تسوية 3%.