Journal of Soil Sciences and Agricultural Engineering

Journal homepage & Available online at: www.jssae.journals.ekb.eg

Engineering and Economic Impact of the Unit Area of Land on Development Farm Irrigation System

Eid, S. F. M.*; Narmeen I. Morsy and A. H. Awwad

Agric. Eng. Res. Inst. (AENRI), Agric. Res. Center (ARC), Egypt

ABSTRACT

The experimental was conducted in different crops during the season of 2020 in Hosh Easa city (latitude 30^0 58\ 10.86\\ N, and longitude 30^0 17\ 04.38\\ E), in El-Beheira governorate. The study was conducted to evaluate the improved surface irrigation and the effect of area shape (length, width, and the number of valves per feddan) on the water applied m^3/fed, irrigation time h/fed, yield kg/fed, and water productivity kg/m^3 and evaluated the economic impact such as irrigation cost, cost of planting and net income with seven crops which were grown (wheat, rice, corn, cotton, tomato, sugar beet and Alfa Alfa). The results were the highest water productivity were under treatments B (No. of valves 1.43/fed) compared with treatments D (No. of valves 1.25/fed), C (No. of valves 1.06/fed) and A (traditional) respectively. For example, the highest value of water productivity for tomato crop was 9.26 kg/m^3 under treatment (B), while the lowest was (7.92 and 8.55 kg/m^3) under treatments D and C respectively compared with treatment (A) which was (6.82 kg/ m^3), and the same trend for all crops. Also the highest values of yield were under treatments (B), compared with treatments D, C and A respectively. For example, the highest values of yield for the wheat crop were (2250 kg/fed.) under treatment (B), while the lowest values of yield for the same crop were (2160 and 2190 kg/fed) under treatments D and C respectively compared with treatment (A) which was (1950 kg/fed), and the same trend for all crops.

Keywords: Improved surface irrigation, economic efficiency, water productivity, water applied.

INTRODUCTION

Many projects aim to raise the standard of living of farms and increase productivity for example, the national project of farm irrigation development in old land tends to improve farm irrigation systems and optimize the unit of land and water to ensure the fairness of water distribution among the farmers. The improving surface irrigation project also aims to reduce rural poverty among the families and work to develop and improve their live for the beneficiaries of the project by increasing and improving farm production for increases average income of these families. Save to 25% of water irrigation, increase yield by 20 % and increase the production of water farm from 36% to 68% (El-Salem *et al*., 2015).

El-Berry *et al*. (2006) said that the agricultural and irrigation Egyptian policies have been working to improve surface irrigation system in the old lands through the national project On-Farm Irrigation Development in the old lands (OFIDO) for improving surface irrigation and increase the productivity in the Egyptian old lands. Eid (2007) reported that the applied water (m^3/fed.) using the developed surface irrigation systems was less than the traditional irrigation methods in all cases at different tested areas. Using the developed surface irrigation systems saved irrigation water about 30% up to 37%. The annual fuel consumption per fed. decreased by decreasing the field length. The developed surface irrigation system has saved pumping unit fuel consumption compared with traditional irrigation system. In general, fuel consumption depends on pumping unit type and its specifications.

Ashour *et al*. (2010) showed that the irrigation improvement system the adequacy of water supply improved to reach about 95 % in winter and about 80 % in summer. Fairness in water distribution along Mesqas improved to reach about 97 %, the pumping cost decreased (about 18 L.E./one irrigation/fed. instead of 50L.E./one irrigation/fed. "before improvement"), Reduction of irrigation time ranged from 50 % to 60 % of that was before improvement, Land saving: There is about 1 % of the total command area has been saved and made available for agriculture and roads (40 % for agricultural and 60 % for roads) and he reported the improvement of farm income by an increase in crop yields ranges from9% to 20% depending on the type of crop. Farmers became very keen with their water application, as they are paying for the cost of operation and maintenance.

Awwad *et al*. (2016) shows that the use of the irrigation system developer the improved the economic and social conditions of Egyptian farmers through the development and use of improved system, water management, and associated practices that promote water use efficiency and decrease drainage problems and then increase agricultural production. Using Marwa develop for irrigating crops led to improve water application efficiency, saving more water, net income, and net income from water units and economic efficiency without observed reduction in yields. Amer *et al*. (2017) reported that the new planting method was suitable for increasing maize growth, increasing grain yield, water saving, water productivity and decreasing irrigation cost. Abou Kheira (2009) studied the impacts of the irrigation improvement project on crop water requirements, crop yields and crop water productivity under changing irrigation and

* **Corresponding author.**
E-mail address: sam67_eid@yahoo.com
DOI: 10.21608/jssae.2022.169127.1109

cultural practices in the northern Nile Delta. Said *et al*. (2016) analyzed water use efficiency in improved surface irrigation 1.49 and 1.08 kg/m^3 for wheat and sorghum; it was 0.87 and 0.631 kg/m^3 under traditional surface irrigation respectively. The saved agricultural land through using buried pipes instead of traditional mesqa ranged from about 2.74 % to 2.067 % and in the lining canal it ranged from1.33 % to 1.04 % which were occupied by the channels and ridges. Average conveyance efficiency values were obtained as 82.4%, 92.7%, and 98.38% respectively for earth mesqa, lining mesqa and buried pipes. The average application efficiency values were 81.5 % under improved surface irrigation and it was 59% under traditional surface irrigation. The irrigation time decreased by using improved surface irrigation 31.39% compared with traditional surface irrigation. The percentage of increase in the productivity of wheat and sorghum under improved surface irrigation was 10.81% and 10.44 % respectively compared with traditional surface irrigation. El-Gindy *et al*. (2010) reported that the yields were affected by fields size, the yield of wheat per feddan increased by 6.82, 9.10 and 18.18 % when the field size increased from 6 kerat to 24, 48, 72 kerat respectively. Also the yield of fababean had the same trend, the seed yield increased by 10.91, 20.00 and 23.64 % when the field size increased from 6 kerat to 24, 48, 72 kerat respectively. The weight of clover cuts per feddan increased by increasing the field size.The irrigation water decreased by increasing field size for yields wheat, faba bean and clover, the quantity of irrigation water for wheat was decreased by 1.44, 3.61 and 7.12 % when the field size increased from 6 kerat to 24, 48, 72 kerat respectively (feddan = 4200m^2&kerat = 175 m^2 &1 feddan = 24 kerat). The feasibility of the field irrigation development project achieved its desired goals and through conducting an analysis of the project it was found that the positive return covers the costs in all years of life. Regarding to the impact of the use of developed field irrigation on crops, the study showed a decrease in the cost of producing an acre of rice from about 2740 pounds on average to about 2126 and 2191 pounds of land equipped innuendos canals and buried pipes respectively, and that productivity is higher per acre by about 3 tons of traditional irrigation land to about 3.8 and 3.5 tons of land with equipped innuendos and buried pipes respectively, The consumption of an acre of rice has also decreased, equivalent to about 2700 m3 water in land-equipped canals innuendos and about 3024 m3 of land fitted with buried pipes. Also, The cost of production for cotton crop per acre has decreased from about 3693 pounds, to about 2913 and 3200pounds of land equipped canals innuendos and buried pipes, respectively, and productivity per acre increased from about 7.4quintars of land with traditional irrigation to about 8.7 and 9.2quintars of land with equipped innuendos and pipes buried respectively, EL Kashef (2016). Girgis *et al* (2010), explained that the implementation of the developed irrigation project led to an increase in crop productivity in Beheira Governorate by 21%, 12%, 18%, 16.75% for wheat, beans, maize and rice, respectively, with cotton by 16.7% in Kafr El-Sheikh governorate and by 4.8% for sugar cane in Qena governorate, and the study indicates The amount of water saved is estimated at 20.9%, 24.2%, 22%, 21%, 14.6%, 8.4%, 33% for wheat, beans, alfalfa, rice, maize, cotton and sugarcane, respectively, they also stressed that the implementation of the developed irrigation project will improve the water distribution system, improve efficiency and equality in water distribution, increase farm productivity and farmers' income, and therefore it needs continuous monitoring and evaluation of its performance level to avoid any deviation from the planned or target. Montaser (2015) showed that modern irrigation (sprinkler and drip irrigation) achieves the following: 1- Savings in variable and total costs and net return per acre because of use modern irrigation systems compared to the surface irrigation system. 2- The fixed costs of the irrigation network and the rent if we follow modern irrigation methods are greater compared to the surface irrigation system. 3-The amount of savings in irrigation water for wheat crop because of use the sprinkler and drip irrigation system is about 538 and 911 m^3, respectively. While the total savings because of use the drip irrigation system in the tomato crop reached about 496 m^3. While the total savings in irrigation water because of use the sprinkler and drip irrigation system in the winter onion crop reached about 409 and 677 m^3, respectively, while the total savings in irrigation water because of use the sprinkler irrigation system in the alfalfa crop was about 750 m^3.

The principal objective of evaluating surface irrigation system is to identify management practices and system configurations that can be feasibly and effectively implemented to improve irrigation efficiency. These goals can be summarized as follows: -

1. Achievement a good irrigation management by increasing conveyance and distribution efficiencies.
2. Decreasing water losses due to poor existing canals.
3. Controlling the distribution of water and getting water to the fields in the timely manner and quantity necessary for the needs of the plant, in addition to savings in the operation and maintenance of the irrigation system.
4. Increasing conveyance efficiency; saving time, decreasing operating energy and increasing cultivated land compared with earthily deed treating canals by using buried pipes.
5. Disposal of the problems of inequitable distribution of water among farmers on the tail end of Mesqa, by unification lifting water from a single point at the top of developed Mesqa which direct reflection of the agricultural production for all farmers.

MATERIALS AND METHODS

Field experimental were conducted in summer and winter crops during season 2020 in HoshEasa city (latitude 30^0 58\ 10.86\\ N, and longitude 30^0 17\ 04.38\\ E), in the project area in El-Beheira governorate.

To evaluate the improved surface irrigation in the old lands; three plots of different areas and different shapes were selected to study the effect of plot length, width and number of valves per feddan on the improved surface irrigation fields and compared with non-improved (traditional irrigation) surface irrigation. These plots were: -

Treatment (A): traditional surface irrigation treatment as control.

Treatment (B): area 125 feddan with 179 valves, length 92-meter, width 46 meter (Number of valves 1.43/fed.).

Treatment (C): area 98 feddan with 123 valves, length 82-meter, width 51 meter (Number of valves 1.25/fed.).

Treatment (D): area 33 feddan with 35 valves, length 114-meter, width 37 meter (Number of valves 1.06/fed.).

In traditional surface irrigation the tertiary canals earthen Mesqas receive irrigation water from individual

farmer's pumping units, it is known that under traditional surface irrigation the pump lifts irrigation water from the branch and the pump specification has a water discharge of 320 m^3/h for an engine capacity 10 hp with a revolution number of 1440 rpm for a head of 15 m.

Water applied (m^3/fed)

Applied water (AW) was calculated as described by Giriappa (1983) as follows:

$$AW = IW + ER \quad \text{..... (1)}$$

Where, IW: irrigation water applied (m^3/fed), using flow meter.
ER: effective rainfall.

Water Productivity (WUE)

Water Productivity (kg/m^3) was calculated according to (Howell, 2003 and Amer et. al. 2017).

$$\text{WUE } (kg/m^3) = \text{yield } (kg/fed)/\text{water applied } (m^3/fed) \quad \text{.....(2)}$$

$$\text{Cost of irrigation } (L.E/ton) = \frac{\text{Cost of irrigation in while season } (L.E/ha)}{\text{Grain yield } (ton/ha)} \quad \text{.....(3)}$$

$$Economic\ efficiency\ for\ capital\ investment\ (\%) = \frac{Net\ profit\ (L.E/fed/season)}{Total\ cost(L.E/fed/season)} \times 100 \quad \text{....(4)}$$

$$Investment\ ration = \frac{Total\ price\ return\ (L.E/fed}{Total\ cost\ (L.E/fed/season)} \quad \text{.....(5)}$$

RESULTS AND DISCUSSION

In this research, the effect of the geometric dimensions of the land on several criteria and measurements was studied and the results obtained were specific to effect of geometric shape of the land on

1- Irrigation Water Applied (m^3/fed)

The data was presented in table (1) showed that, with wheat crop under improved surface irrigation system, the value of water applied under treatment B decreased compared with treatment C and D by a ratio 6.7% and 12.5% respectively. While the water applied decreased under improved surface irrigation system by a ratio 15.15%, 9.1% and 3% with treatments B, C and D respectively relative to the traditional irrigation system for wheat crop. Water applied has the same trend for all crops, for example, the data was presented in table (2) showed that, with Cotton crop under improved surface irrigation system, the value of water applied under B decreased compared with treatment C and D by a ratio 3% and 5.9% respectively. While the water applied decreased under improved surface irrigation system relative to the traditional irrigation system for Cotton crop by a ratio 20%, 17.6% and 15.1% under treatments B, C and D respectively.

Table 1. Effect of shape of the land on some indicators of wheat crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	1950	1980	-	-	0.98	-	36
B	2250	1680	300	15.15	1.34	36.73	28
C	2190	1800	180	9.09	1.22	24.49	30
D	2160	1920	60	3.03	1.13	32.65	32

Generally, Data in tables (1 to7) showed that under treatments B, C and D, the lowest value of water applied was found under improved surface irrigation system with all types of cropscompared with traditional irrigation system with all crops.

Table 2. Effect of shape of the land on some indicators of cotton crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	1102.5	4840	-	-	0.23	-	88
B	1260	3870	970	20.04	0.33	43.47	65
C	1228.5	3990	850	17.56	0.31	34.78	67
D	1181.25	4110	730	15.08	0.29	26.09	69

Table 3. Effect of shape of the land on some indicators of alfa alfa crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	12500	2860	-	-	4.37	-	52
B	15000	2280	580	20.28	6.58	50.57	38
C	14700	2460	400	13.99	5.98	36.84	45
D	14500	2640	220	7.69	5.49	25.63	44

Table 4. Effect of shape of the land on some indicators of rice crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	3500	6270	-	-	0.56	-	114
B	4000	5100	1170	18.66	0.78	39.28	85
C	3900	5280	990	15.79	0.74	32. 14	88
D	3750	5520	750	11.96	0.68	21.42	92

Table 5. Effect of shape of the land on some indicators of sugar beet crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	18000	2420	-	-	7.43	-	44
B	20000	2100	320	13.22	9.52	28.13	35
C	19700	2280	140	5.79	8.64	16.29	38
D	19000	2400	20	0.83	7.92	6.59	40

Table 6. Effect of shape of the land on some indicators of tomatoes crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	18000	2640	-	-	6.82	-	48
B	20000	2160	480	18.18	9.26	35.78	36
C	19500	2280	360	13.64	8.55	25.37	38
D	19000	2400	240	9.09	7.92	16.13	40

Table 7. Effect of shape of the land on some indicators of corn crop

Treatments	Grain yield	water applied	Water save		Water productivity	Increase of water productivity	Irrigation time
	(kg/fed.)	(m^3/fed.)	(m^3/fed.)	(%)	(kg/m^3)	%	h/fed
A	1000	3410	-	-	0.29	-	62
B	2000	2820	590	17.30	0.71	144.24	47
C	1900	3000	410	12.02	0.63	117.24	50
D	1850	3120	290	8.50	0.59	103.45	52

2- Yield production (kg/fed)

The data was presented in table (1) showed for wheat crop under improved surface irrigation system, the value of yield production for treatment B increased compared with treatment C and D by a ratio 2.6% and 14% respectively. Whilethe values of yield production increased under improved surface irrigation system compared with traditional irrigation system forwheat cropby a ratio 13.3%, 11% and 9.7% for treatments B, C and D respectively.

Yield has the same trend for all crops, For example, the data presented in table (2) showed that for cotton crops under an improved surface irrigation system, the value of yield production under treatment B increased compared with treatments C and D by a ratio of 2.5% and 6.25% respectively. While the values of yield production increased under an improved surface irrigation system relative to the traditional irrigation systems for the Cotton crop by a ratio of 12.5%, 10.25% and 6.67% with treatments B, C and D respectively.

Generally, Data in tables (1 to7) showed that under treatments B, C and D, the highest value of yield production was found under an improved surface irrigation system with all types of crops compared with a traditional irrigation system with all crops.

Generally, the decrease in grain yield or production yield under treatment A (control) may be due to the increasing of applied water that makes partial aeration in the upper part of root zone is lacking. Also, the increasing wetting of the soil top may be reduces fertilizers from the root zone.

3- Water Productivity (kg/m^3)

The data presented in table (1) showed that, for wheat under the improved surface irrigation system, the value of water productivity for treatment B increased compared with treatments C and D by a ratio of 9% and 15.7%, respectively. But, the water productivity increased for the improved surface irrigation system compared with the traditional irrigation system by about 86.86%, 19.7%, and 13.27% for treatments B, C, and D, respectively.

Water Productivity has the same trend for all crops. For example, the data was presented in table (2) for cotton crop under improved surface irrigation system indicated that the productivity for treatment B increased compared with treatments C and D by a ratio 4.76% and 14.3%, respectively. While it increases for the improved surface irrigation system relative to the traditional irrigation for the cotton crop by a ratio of 33.33%, 30%, and 22.22% with B, C, and D, respectively.

Generally, Data in tables (1 to 7) showed that for treatments B, C and D, the highest productivity value was found under an improved surface irrigation system for all types of crops compared for traditional irrigation system with all crops.

4- Irrigation Time (h/fed)

The data presented in table (1) showed that, in the wheat crop under an improved surface irrigation system, the time irrigation for treatment B decreased relative to treatments C and D by a ratio of 6.66% and 12.5%, respectively. While the values of irrigation time decreased under the improved surface irrigation system compared with traditional irrigation system for the wheat crop by a ratio of 22.22%, 16.66% and 11.11% with treatments B, C and D, respectively.

Irrigation time has the same trend for all crops, for example, in the data presented in table (2) for the cotton crop under an improved surface irrigation system, the value of irrigation time under treatment B decreased compared with treatments C and D by a ratio 3% and 5.8% respectively. While the values of irrigation time decreased under improved surface irrigation system compared with traditional irrigation systems for the cotton crop by a ratio of 26.13%, 23.9% and 21.6% with treatments B, C and D respectively.

Generally, Tables (1 to 7) showed that the lowest value of irrigation time was found under an improved surface irrigation system for all types of crops compared with traditional irrigation system.

5- Water saving (m^3/fed)

According to the water saving, tables (1 to7) in the could be noticed that treatment B had the highest value of water saving compared with treatments C, D, and A respectively, for example, water saving with corn crop, the data was presented in table (7) showed that under treatment (B) was (590m^3/fed) compared with treatments C and D which were (410 and 290m^3/fed) respectively. These amounts of saved water are enough to irrigate a third of an fedden with a developed irrigation system for corn crop.

6- Economic Analysis

The economic impact such as irrigation cost and the total cost of planting which includes the operation cost, fertilizing, the harvest, transportation and seeds except for the cost of renting and net profit. So there are many criteria that have a role in economic analysis, including:

a- Cost of irrigation (LE /fed.)

Cost of irrigation in the whole season for all treatments was calculated on the basis of cost of energy, the maintenance and labors.

The data presented in table (8) showed that, for wheat crops under an improved surface irrigation system, the cost of irrigation under treatment B decreased compared with treatment C and D by a ratio of 6.5% and 12.35% respectively. While the cost of irrigation decreased under an improved surface irrigation system compared with the traditional irrigation system for the wheat crop by a ratio of 64.233%, 61.71% and 59.2% with treatments B, C and D respectively.

Table 8. Cost of input and output items of wheat crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	4136	3805	3813	3823
	Cost of irrigation (LE/fed).	397	142	152	162
	Total cost (LE/fed).	4533	3947	3965	3985
List of Outputs	Grain yield (kg/fed).	1950	2250	2190	2160
	Total price (LE/fed).	8450	9750	9490	9360
	Net profit (LE/fed).	3917	5803	5525	5402
Cost of irrigation/ton (LE).		203.59	63.11	69.41	75
Economic efficiency capital / investment (%)		86.41	147.02	139.34	135.56
Investment ratio (LE/LE)		1.86	2.47	2.39	2.35

The cost of irrigation has the same trend for all crops, for example, the data was presented in table (9) with tomatoes crop under improved surface irrigation system, the cost of irrigation under treatment B decreased compared with treatment C and D by a ratio 6.8% and 10.28% respectively. While the cost of irrigation decreased under improved surface irrigation system compared with traditional irrigation system for tomato crop by a ratio 46.66%, 42.77% and 40.55% with treatments B, C and D respectively.

Table 9. Cost of input and output items of tomatoes crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	14350	11600	11600	11600
	Cost of irrigation (LE/fed).	900	480	515	535
	Total cost (LE/fed).	15250	12080	12115	12135
List of Outputs	Grain yield (kg/fed).	18000	20000	19500	19000
	Total price (LE/fed).	36000	40000	39000	38000
	Net profit (LE/fed).	20750	27920	26885	25865
Cost of irrigation/ton (LE).		50	24	26.41	28.16
Economic efficiency capital / investment (%)		136.07	231.13	221.91	213.14
Investment ratio (LE/LE)		2.36	3.31	3.22	3.13

Generally, Data in tables (8 to 14) showed that under treatments B, C and D, the lowest cost of irrigation was found under improved surface irrigation system with all types of crops compared with traditional irrigation system with all crops.

b- Cost of planting (LE /fed.)

The data was presented in table (10) showed that, with rice crop under improved surface irrigation system, the cost of irrigation under treatment B decreased compared with treatment C and D by a ratio 6.5% and 12.35% respectively. While the cost of irrigation decreased under improved surface irrigation system compared with traditional irrigation system for wheat crop by a ratio 64.233%, 61.71% and 59.2% with treatments B, C and D respectively.

Table 10. Cost of input and output items of rice crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	2450	3950	3950	3950
	Cost of irrigation (LE/fed).	3000	1000	1035	1080
	Total cost (LE/fed).	5450	4950	4985	5030
List of Outputs	Grain yield (kg/fed).	3500	4000	3900	3750
	Total price (LE/fed).	14000	16000	15600	15000
	Net profit (LE/fed).	8550	11050	10615	9990
Cost of irrigation/ton (LE).		857.14	250	265.38	288
Economic efficiency capital / investment (%)		156.88	223.23	212.93	198.21
Investment ratio (LE/LE)		2.57	3.23	3.13	2.98

The cost of irrigation has the same trend for all crops, for example, the data was presented in table (9) with tomatoes crop under improved surface irrigation system, the cost of irrigation under treatment B decreased compared with treatment C and D by a ratio 6.8% and 10.28% respectively. While the cost of irrigation decreased under improved surface irrigation system compared with traditional irrigation system for tomatocrop by a ratio 46.66%, 42.77% and 40.55% with treatments B, C and D respectively.

Generally, data in tables (8 to 14) showed that under treatments B, C and D, the lowest cost of irrigation was found under improved surface irrigation system with all types of cropscompared with traditional irrigation system with all crops.

Table 11. Cost of input and output items of alfalfa crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	1440	1120	1120	1120
	Cost of irrigation (LE/fed).	1050	500	540	580
	Total cost (LE/fed).	2490	1620	1660	1700
List of Outputs	Grain yield (kg/fed).	12500	15000	14700	14500
	Total price (LE/fed).	4166.67	4999.95	4899.95	4833.29
	Net profit (LE/fed).	1676.67	3379.95	3239.95	3133.29
Cost of irrigation/ton (LE).		84	33.33	36.73	40
Economic efficiency capital / investment (%)		67.34	208.64	195.18	184.31
Investment ratio (LE/LE)		1.67	3.09	2.95	2.84

Table 12. Cost of input and output items of cotton crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	6930	5620	5620	5620
	Cost of irrigation (LE/fed).	750	400	415	425
	Total cost (LE/fed).	7680	6020	6035	6045
List of Outputs	Grain yield (kg/fed).	1102.5	1260	1228	1181.25
	Total price (LE/fed).	16000	18000	15600	15000
	Net profit (LE/fed).	8320	11980	9565	8955
Cost of irrigation/ton (LE).		680.27	317.46	337.95	359.79
Economic efficiency capital / investment (%)		108.33	199.00	158.49	148.14
Investment ratio (LE/LE)		2.08	2.99	2.58	2.48

Table 13. Cost of input and output items of sugar beet crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	4350	4250	4250	4250
	Cost of irrigation (LE/fed).	750	400	435	460
	Total cost (LE/fed).	5100	4650	4685	4710
List of Outputs	Grain yield (kg/fed).	18000	20000	19700	19000
	Total price (LE/fed).	1080	12000	11820	11400
	Net profit (LE/fed).	5700	7350	7135	6690
Cost of irrigation/ton (LE).		41.67	20	22.03	24.21
Economic Efficiency capital / investment (%)		111.76	158.06	152.29	142.03
Investment ratio (LE/LE)		0.21	2.58	2.52	2.42

Table 14. Cost of input and output items of corn crop under different shapes of the land

Economical items	Characters	Treatments			
		A	B	C	D
List of Inputs	Cost of planting (LE/fed).	2100	2000	2000	2000
	Cost of irrigation (LE/fed).	875	480	510	530
	Total cost (LE/fed).	2975	2480	2510	2530
List of Outputs	Grain yield (kg/fed).	1000	2000	1900	1850
	Total price (LE/fed).	4000	8000	7600	7400
	Net profit (LE/fed).	1025	5520	5090	4870
Cost of irrigation/ton (LE).		875	240	268.42	286.49
Economic efficiency capital / investment (%)		34.45	222.58	202.79	192.49
Investment ratio (LE/LE)		1.34	3.23	3.03	2.92

c- Total cost (LE/fed)

The data presented in tables (8 to 14) showed that with all crops under an improved surface irrigation system, the total cost under treatment A increased compared with treatments B, C and D for example, the data presented in table (13) with sugar beet crop under treatment A was (5100 LE/fed) compared with treatments B, C and D which was average about (4681LE/fed).

d- Net profit (LE/fed)

According to the economic evaluation, (tables 8 to 14) it could be noticed that treatment B had the highest value of net profit compared with treatments C, D, and A respectively, because it lower the costs of irrigation in the whole season.

On the other hand, it gave a high value of grain yield or production yield and consequently decreased the costs of irrigation per ton and increased the economic efficiency for capital investment and investment ratio compared with the other treatments.

For example, the net profit with corn crop, the data presented in table (14) showed that under treatment (A) was (1025 LE/fed) compared with treatments B, C and D which were (5522, 5090, 4870 LE/fed) respectively.

Generally, Data in Tables (8 to 14) indicated that irrigation cost and net income (net profit) crops were affected by plot shape and the number of valves per plot. Data recorded that the cost of irrigation decreased and net income increased under treatment B for all crops.

In conclusion, in this paper, the geometric shape of the land, treatment (B) with the area 125 feddan with 179 valves length of 92-meters, width of 46 meters (number of valves 1.43/fed) was always better and more suitable than the traditional method and other treatments in reduction of costs, increasing water save, water productivity and crop growth, yield components and grain yield.

Recommendations

The necessity of using and applying technical package with regard to the irrigation methods used and trying to adopt developed irrigation methods (with different dimension of area to control the number of valves) that are through it, large quantities of water can be saved, which can be used to cultivate new areas, and it also saves cost of production.

REFERENCES

AbouKheira, A. A. (2009). Crop water productivity as influenced by irrigation improvement in the Nile Delta. An ASABE Meeting Presentation.

Amer M. H. ; S. A. Abd El Hafez and M. B. Abd El Ghany (2017). Water Saving In IrrigatedAgriculture in Egypt (Case Studies and Lessons Learned) International Book Market Service Ltd., member of Omniscriptum Publishing Group, Beau Bassin 71504, Mauritius.

AshourM. A.; S. T. El-Attar; K. A. Amen and H. M. AboEl-Eyon(2010)Irrigation improvement system and its effect on water management in BeniAdi Village (Casestudy).Journal of Engineering Sciences, Assiut University, Vol. 38, No. 6, pp.1345-1365.

Awwad, A. H.; A. S. H. Mohammed and M. M. A. Shabana (2016) Evaluation of Water Management and Requirements Under Developed Surface Irrigation System. J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 7(11): 847 – 855.

Eid, S. F. M., (2007). Applied Engineering Studies For Increasing DevelopedSurface Irrigation Systems Efficiency Using Local Components. Ph. D. Thesis, Agric. Eng. Dept., Fac. of Agric., Cairo Univ.

El-Berry A. M, El Ebaby F. G, HassanS. S, Fattouh S. M. (2006). Performance of locally developed surface irrigation in sugarcane production Misr J.Agic. Eng., 23(1): 169 – 191.

El-Gindy A.M.; El-KatibS.I.andEid S. F. (2010).Effect of Fragmentation on Irrigation, Area Losses and Yield of Some Crops in SohagGovernorate.The 17th.Annual Conference of the Misr Society of Agic. Eng., 1184 - 1192.

EL-Kashef, G. H. A. (2016).Economic Evaluation Of Developed Field Irrigation Systems Under Limited Financial Resources In Egypt.Ph. D. Thesis, Agric. Eng. Dept., Fac. of Agric., Ain Shams Univ.

EL-SalemM.H.;El-Gindy A.M., Mustafa M.M. and Morsy N.I. (2015).An Economic Study Of The Efficiency Of Water Irrigation In Kafr El-Shiekh Governorate. 4 th International Conference of Agricultural &Bio Engineering "the rol of agricultural and biological engineering to achieve agriculture strategy regionally and internationally ", 6-7 September 2015, vol. 93, number 5, 2015.

Girgis, A. E. ; K. Sohair and Arthanious(2010). An Economic Study of The Efficiency Of Water Irrigation Systems In Some Governorates In A.R.E. J. Agric. Economic and Social Sci., Mansoura Univ.,Vol.1((10),October, 2010

Giriappa, S.(1983). Water use efficiency in agriculture .Oxford and IBH publishing C.O. New Delhi.

Montaser, M. H. (2015). An Economic Study Of The Economic Returns To Modern Irrigation Systems For The Most Important Field Crops In The New Lands In Qena Governorate. The Egyptian Journal of Agricultural Economics,Vol.4(25),Dec., 2015.

Howell, A. T. (2003).Irrigation efficiency. United States Dept. of Agric. (USDA), Bushland, Taxas, U.S.A. Marcel Dekker, Inc. New York.

Said El din, M.R.; M.Y. El–Ansary; M.A. Awaad and A.S.H. Mohammed, (2016). Evaluation of integrated surface irrigation management in the old lands.J. of Soil Sci. and Agric. Eng., Mansoura University.

الأثر الهندسى والاقتصادي لوحدة المساحة من الارض علي نظام الرى الحقلى المطور

سمير فتوح محمد عيد ، نارمين ابراهيم مرسي و امين حسين عواد

معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – وزارة الزراعة.

الملخص

تم إجراء التجربة الحقلية على محاصيل صيفية وشتوية خلال الموسم الزراعي2020 بمدينة حوش عيسى (خط عرض \\10.86 \58 ^{0}30 وخط طول \\04.38 \17 ^{0}30)، بمحافظة البحيرة. بهدف تقيم نظام الري السطحي المطورو تأثير الشكل الهندسي (الطول والعرض وعدد المحابس لكل فدان) علية ،عن طريق تقييم المياه المضافة م^{3}/فدان ووقت الري ساعة/فدان، والعائد كجم/فدان وكفاءة الاستخدام المائي كجم/م^{3} كما تم تقييم الأثر الاقتصادي مثل تكلفة الري وتكلفة الزراعة وصافي الدخل على سبعة محاصيل هما (القمح والقطن والبرسيم والأرز والسكر والذرة والطماطم). ويمكن تلخيص النتائج التي تم الحصول عليها على النحو التالي:1- كانت أعلى قيم لكفاءة الاستخدام المائي تحت المعاملة (B) مقارنة بالمعاملات (D وC وA) على التوالي. فعلى سبيل المثال، كانت أعلى قيم لكفاءة الاستخدام المائي لمحصول الطماطم (9.26 كجم/م^{3}) تحت المعاملة (B)، في حين كانت أدنى قيم لكفاءة الاستخدام المائي لنفس المحصول (7.92 و8.55 كجم/ م^{3}) تحت المعاملة (D وC) على التوالي مقارنة بالمعاملة (A) التي كانت (6.82 كجم/ م^{3})ونفس السلوك لجميع المحاصيل.2- في حين أن أعلى قيم لانتاجية الحبوب كانت تحت المعاملة (B) مقارنة بالمعاملات (D و C و A) على التوالي. فعلى سبيل المثال، كانت أعلى قيم لمحصول الحبوب للقمح (2250 كجم/فدان) تحت المعاملة (B)، في حين كانت أدنى قيم هي (2160 و2190 كجم/ فدان) تحت المعاملتين D وC على التوالي مقارنة بالمعاملة (A) التي كانت (1950 كجم/ فدان)، ونفس السلوك لجميع المحاصيل.

الكلمات الدالة :الري السطحي المطور، الشكل الهندسي، كفاءة الاستخدام المائي، الانتاجية، المياه المضافة.