Increasing economic returns for sugar cane crop by development irrigation system (gated pipes) in Egypt

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Abstract: Egypt is facing the steady increase of its population and in the mean time, it facing the stability of both agricultural areas and available water supply, this fact caused the increase of the food gap between its production and consumption. Therefore, the state is considering carrying out horizontal expansion programs in order to add new areas to the current agricultural areas under the current limited water. Therefore using development irrigation system by gated pipes is considered one of the most important aimed methods for all field crops, especially crops consuming water with a high degree, including the sugar cane crop in Egypt. So two field experiments were carried out at different three regions in the texture soils and weather conditions (El Minia region - middle Egypt, (Luxor region – at beginning upper Egypt) and (Aswan region - at the end of upper Egypt) during seasons 2015 and 2016 seasons. The present research was carried out to evaluated and compare (from view point of water and economic) development irrigation system by gated pipes with common conventional irrigation system which practiced in these regions for sugar can crop ***(Saccharum officinarum* L.)** Four treatments were arranged in a spilt-plot design. Two of them system irrigation (surface irrigation & development irrigation system by gated pipes) and the others planting methods (furrows & beds). The results also indicated from view point of economic the highest values of field water use efficiencies (7.56, 6.21 and 4.81 kg/m^3) were obtained from using the treatment A_2b_2 (gated pipe in beds) in each region El Minia, Luxor and Aswan respectively. The highest values of total income, production, financial benefits (L.E/ area), net return of each and water irrigation (L.E /m3) and economic efficiency were gained with it for all regions. Therefore, the economics of irrigation water becomes very important for planting irrigation management project where the over irrigation practices by farmers usually lead to low irrigation efficiency, water logging and high losses of water. It could be recommended to application gated pipes in beds to produce high yield with less amount of water applied which led to maximize the economic returns of the sugar cane crop under the three different regions of the climatic conditions in and texture soils in Egypt.
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1. Introduction

Agricultural sector plays an important role in the economic development in Egypt. It is considered one of the national economy basis, and the main income source for more than half of Egypt's population. Agriculture is responsible for satisfying the consumers' needs for clothing and food. In addition, it provides the industry sector with raw materials needed for various industries. The extension of this role requires achieving the economic development which is derived from two main sources: horizontal and vertical agricultural expansion. Horizontal agricultural expansion depends on the availability of the production resources. In arid regions, water resources are considered the scarcest element among other economic production resources. Consequently, it is not only one of the man determinants but also the strategic one which determines the horizontal expansion through reclamation of new lands.

The optimal use of water is the corner stone of the agricultural development sector because the present water sources available in Egypt are not enough for the future horizontal agricultural expansion, in the scope of the present techniques and irrigation practices. Comprising the 21th century challenges arises under conflicts on water shares of Egypt, and the attempt to continue the policy of agricultural horizontal expansion, it gets worst. This matter shows the necessity of achieving the maximum efficiency of water sources in Egypt through some parameters which can be used in achieving the best use of the available water sources in Egypt.

In this connection ***Smith et. al. (1997)*** indicated that using gate pipe system provided many benefits.

1-Demonstrated that water applied more evenly and more efficiently could increase crop yields.

2-Provided controllable, consistent, and accurate delivery of the water right.

3-Reduced the need to divert 5.5 acre-feet per acre from the Clear-water ditch to 3.3 acre-feet per acre.

4-Improved water quality in the Lostine River by reducing tailwater return flows and reducing sediment yield.

Kholeif et.al. (1997) showed that, modern irrigation systems in sugar under Upper Egypt conditions gave highest cane yield and quality.

Hassan (1998) reported that there are many methods for improving the performance of surface irrigation, but all of then depend up on the main factors related to soil characteristics, leveling and application method. they stated that the use perforated pipe system instead of ditches for conveying and distributing the irrigation water over the entire field may improve the surface irrigation, avoid weed problems, avoid loss of productive land, avoid loss of water by seepage and evaporation. And also decreases the irrigation water losses up to 25 % during distributing the irrigation water.

El-Tantawy et al. (2000) stated that developed surface irrigation means using perforated pipe system and precision land leveling on sugarcane area in old valley in Egypt.

Osman (2000) stated that using gated pipes, led to saving water by about (29.64%, 29.9%, 14.5% and 19.7%) in cotton, wheat, corn ad rice respectively compared with traditional (flooding) system.

Abo Solimam, et al (2002) found that using gated pipes could save irrigation water by 16.94% for maize crop compared to traditional surface furrow irrigation.

Osman (2002) showed that using gated pipes increased the mango yield by 377.2% and saved irrigation water by 19.8% compared with traditional system. Also, water utilization efficiency by using improved surface irrigated mango with gated pipes was increased by 70.7% compared with traditional methods. Also he found that water utilization efficiency by using improved surface irrigated mango with gated pipes was increased by 70.7% compared with traditional methods.

Abo Soliman et al (2008) found that the lowest amount of water applied, water consumptive use water losses %, the highest values of field water use, crop water use efficiencies (kg m^{-3}) and water application efficiency % were obtained under gated pipes, 60 m border length and 12 m border width. They add that gated and concrete pipes could save irrigation water by 9.2 and 6.825 for wheat crop, while these values were 12.52, 5.815 for soybean crop, respectively, compared to traditional field ditch. They also added that water application efficiency was higher under gated pipes (79.375) followed by concrete pipes (72.665), while traditional field ditch was the lowest one (66.855). It was expected that water application efficiency would be improved with gated and concrete pipes due to uniform water distribution from the outlets compared to traditional field ditch, which reduces the percolation losses.

Abou El- Soud (2009) found that the depth of the applied water to maize were72.2 and 79.4 cm for gated pipes and traditional surface irrigation systems, respectively, while the depths of water applied to sugar beet were 64.1 and 75.0cm for the same irrigation systems, respectively. The water consumed and stored by maize and sugar beet with different irrigation systems took the same trend of applied water. The traditional surface irrigation system recorded the highest depths of water applied, stored and consumed. The obtained results indicated that the most moisture extraction by maize and sugar beet roots was within the upper 15cm soil layers and then it decreased gradually in the deeper layer Also, the soil extraction patterns with gated pipes system was approximately similar to the with the traditional surface irrigation system. He also found that water application efficiency value increases as the amount of water applied with each irrigation decreases. The values of irrigation application efficiency for maize are 82.2 and 75.5% with gated pipes and traditional surface irrigation systems, respectively, while the value of water application efficiency for sugar beet are 79.5 and 71.7% for gated pipes and traditional surface irrigation systems, respectively.

***Sonbol et al. (2010*)** found that the irrigation by gated pipes system and surface drip irrigation (single lateral) systems achieved the highest values of water distribution efficiency. It can be recommended to use gated pipes as modified surface irrigation method to irrigate heavy clay soils especially under condition of salt affected soils, while subsurface drip irrigation can be used properly in case of water shortage. They also found that the highest root, sugar yield, sucrose percentage and quality of juice were produced when sugar beet plants were irrigated by gated pipes. While the lowest root and sugar yield were achieved with irrigation by double line of subsurface drip irrigation.

Jibin and Foroud **(2007)** found that the gated pipes gave a water saving of 25-28% and 19-29% increase in water use efficiency and 25% of electricity energy saving compare to conventional basin irrigation.

Abd El- Rheem 2010 found that irrigation in beds leads to an increase in productivity and also more water saving with equals 20 % m3/fed. per year, decreasing the costs of the product's materials, decreasing the irrigation time, and rising the total irrigation's efficiency.

Abd El – Fattah (2011), showed that gated pipes technique is a promising practice in improving surface irrigation, the convenient irrigation method in Egypt several advantages could be obtained by using gated pipes.

- Good uniform distribution of irrigation water.
- Low energy needed in its irrigation operations.
- High water saving
- Gained about 10 % from cultivated lands.

Ndeketeya et al. (2014) reported that there was a significant difference in the sugar-cane fresh yield and sucrose content of furrow irrigated and drip irrigated plots with the former having better results. ln 2009, there was a slight increase in fresh weight of 2.0t and l.25t for drip and furrow systems, respectively. Sucrose content increased slightly by 0.l5t for drip, and 0.2t for furrow system. For both treatments benefit cost ratio was greater than zero and net present value was positive, showing that they are profitable and viable projects.

In general, it could be concluded that water is fast become an economically scarce resource in many areas of the world. So, the use of system irrigation should give favorable crop yield and optimum use of water. Therefore, estimating economic of irrigation water become very important for planning irrigation management project where the over irrigation practice by the farmer usually lead to low irrigation efficiency, water logging and high losses of water and fertilizer so the proper water management not only accurate determination of crop water requirements but also helps to know how, when and how much water should be applied to get high efficiency of each unit of water applied.

The aim of this work is to evaluated and compare (from view point of water and economic) development irrigation system by gated pipes with common conventional irrigation system which practiced in these region for sugar can crop (Saccharum officinarum L.).

2. Materials and methods

Two field experiments were carried out for two seasons of 2015 and 2016 seasons, in the farmer fields sugar cane crop at regions El Minia, Luxor, Aswan under different texture soils and weather. The present research was carried out to evaluated and compare (from view point of water and economic) development irrigation system by gated pipes with common conventional irrigation system which practiced in these region for sugar can crop (***Saccharum officinarum L***.).

The experiments were included two irrigation systems (A) (surface irrigation & improving surface by gated pipes) and two planting method (B) (furrow & beds) with four replication so that experiment was arranged in split plot design. The treatments of irrigation systems were randomly distributed in the main plots and planting method treatments were randomly distributed in the sub-plots.

Soil analysis showed tat the experimental soils were clay and salty clay and sand loam for three regions, El Minia, Luxor, Aswan respectively. other agriculture practices required for growing sugar cane were carried out as usually practice in all regions accept irrigation system and planting method.

Recorded data:

Total yield (ton/ fed):

1. Single stalk weight (kg): was calculated by the following equation:

Stalk weight (kg) = Weighed cane yield per plot (kg) / number of Millable stalk per plot (kg).

2. Number of millable stalks/fed: was recorded.
3. Millable cane yield: was calculated as

(Cane yield per plot / plot size) x 4200

Irrigation Water Measurements

Improved surface irrigation (gated pipes) the quantity of water applied was measured by water meters during every irrigation, ***(Brater and King, 1976)***. On the other hand surface irrigation the quantity of water applied was measured in studied area by using a rectangular sharp crested weir. The discharge was calculated using the following formula.

$Q = CLH^{3/2}$ ***(Masoud, 1967)*****.**

Where

Q: The discharge in cubic meters per second.

L: The length of the crest in meters.

H: The head in meters.

C: An empirical coefficient that must be determined from discharge measurements.

Field water use efficiency (F.W.U.E.)

Field water use efficiency is the weight of marketable crop produced per the volume unit of applied irrigation which was expressed as cubic meters of water (**Michael**, 1978).

It was calculated by the following equation:

$$\text{F.W.U.E.} = \frac{\text{Yield (kg/fed.)}}{\text{Water applied } (m^3/\text{fed.})} = (\text{kg}/\text{m}^3)$$

Economic Analysis

***Production**

Production includes the main product represented for potato crop measured in ton / fed.

***Variable costs**

Variable costs include cash costs for purchased inputs like seeds, fertilizer, wages hired labors and machines, etc.

***Fixed costs**

Fixed costs such as land rent, taxes and management charges do not vary with the level of production.

***Total income**

Total income includes the value of main out put ton per feddan were sold at the local market price.

***Return per unit of water**

In Egypt, water is provided without charge to the farmer but estimation of return per unit of water can be taken as index to the relationship between water applied and the value of crop production ***(Division of Agricultural Sciences Irrigation Costs 1978***).

Economic efficiency:

Economic efficiency refers to the combination of inputs that maximize individual or social objectives. Economic efficiency is defined in terms of two condition. Necessity and sufficiency. Necessary conditions is met in production process when there is producing the same amount with fewer inputs or producing more with the same amount of inputs. But, the sufficient condition encompasses individual or social goals and values **(John and Frank, 1987**) It was calculated by the formula:

Economic efficiency = Net profit (L.E/ fed) / Total costs (L.E /fed**)**

-The economic benefits(a):

At the end of study the economic benefits (LE/area) as result from saving of water + saving of yield + saving of quantity water + the saving of irrigation time + saving of irrigation costs were calculated.***(Abd El Ati et. al 2014)***

Statistical analysis:

The proper statistical analysis of all data was carried out according **to Gomez and Gomez (1984).** Homogeneity of variance was examined before combined analysis the differences between means of the different treatments were compared using the least significant difference (LSD) at 5% level.

3. Results and discussion

1-Total yield (ton/ fed):

Total yields (ton / fed). was presented in Table (1) the results in Table (1) show that system irrigation and the planting method had a significant effect on millable cane. The highest values of mill able cane sugar yields were obtained from treatment A_2b_2 (gated pipes in beds) (50.625, 49.635 and 54.560 ton / fed.) for El-Minia, Luxor and Aswan regions respectively. While the lowest values of millable cane were obtained from conventional method (surface irrigation in furrowA1b1 (common method in experimental regions) (45.260, 43.525 and 47.025 ton / fed) for El-Minia, Luxor and Aswan regions respectively. These results are in agreement with those reported by ***El-Monoufi et al (1993), Abd El Rheem 2010 and Abd El Fattah (2011).*** In general, the improving irrigation by gated pipes (furrow & beds) produced highest values of total yield and recoverable sugar yield. So planting the sugar cane by development irrigation (gated pipes) solves the problem of decreasing of the productivity, This might be due to increase the cultivated area of land instead of irrigation canals, reduce the spread of weed and diseases. In general, it could be concluded development irrigation system becomes very important for obtaining a high productivity where conventional irrigation practiced by the farmers usually leads to low irrigation efficiency, water logging and high losses of water and fertilizer so the proper water management not only accurate determination of crop water requirements but also helps to know how, when and how much water should be applied to get high efficiency of each unit of water applied. So improving irrigation by gated pipes is responsible for obtaining a high productivity of sugar cane with least possible amount of water applied.

Table (1): Productivity (ton / fed.) as affected by irrigation system and planting methods for each regions (El-Minia – Luxor – Aswan) in the two studied seasons.

Irrigation systems (A)	Regions								
	El Minia			Luxor			Aswan		
	(B) planting method			(B) planting method			(B) planting method		
	(B_1) in furrow	(B_2) in beds	Mean (A)	(B_1) in furrow	(B_2) in beds	Mean (A)	(B_1)in furrow	(B_2) in beds	Mean (A)
A1	**45.280**	**47.125**	**46.203**	**43.525**	**44.875**	**44.200**	**47.025**	**47.975**	**47.500**
A2	**47.700**	**50.625**	**49.163**	**48.225**	**49.635**	**48.930**	**49.900**	**54.560**	**52.230**
Mean (B)	**46.490**	**48.875**	**47.683**	**45.875**	**47.225**	**46.665**	**48.463**	**51.268**	**49.865**
LSD									
5%	**0.476**	**0.451**	**0.637**	**0.322**	**0.450**	**0.637**	**18.997**	**14.633**	**20.694**
1%	**0.875**	**0.683**	**0.966**	**0.591**	**0.682**	**0.965**	**34.865**	**22.175**	**31.354**

Where; ***A_1= surface irrigation; b_1= irrigation the furrow; A_2=Improving surface irrigation by gated pipes; b_2= irrigation in beds.***

2-Water use efficiency (WUE):

The water use efficiency is obtained by evaluating the two parameters of total yield per unit of water applied. WUE is a tool for maximizing crop production per each unit of water irrigation. Effect of the system irrigation and different planting methods on WUE is presented in Table (2). From the presented data, it is clear that values of WUE of sugar cane differed from one treatment to other.

The highest values of filed water use efficiency were (7.56, 6.21 and 4.81) obtained from treatment A_2b_2 (gated pipe in beds) in each region El Minia – Luxor– Aswan respectively. This is mainly due to the higher yield of sugar cane and decrease water applied in this treatment compared with the other treatments. While the lowest value of filed water use efficiency were (4.56, 3.64 and 2.67) obtained from treatment A_1b_1 (surface irrigation in furrow) for each region El Minia – Luxor– Aswan respectively. These results indicated that the using irrigation system by gated pipes in beds is the best treatment from the view point of water and economic for sugar cane yield.

Table (2): Values of total yield (kg/ fed.) of sugar cane crop, water applied (m^3/fed) and field water use efficiency (kg/m^3) in the two studied seasons for each region.

Treatments		Water applied (m3/fed)	Total yield (kg/ fed.)	Field water use efficiency (kg/ m3)
El Minia region				
Surface irrigation	In furrow	9919.10	45280	4.56
	In beds	8558.42	47125	5.51
Improving surface irrigation by (gated pipes)	In furrow	7689.77	47700	6.20
	In beds	6692.76	50625	7.56
Luxor region				
Surface irrigation	In furrow	11951.76	43525	3.64
	In beds	9916.38	45875	4.63
Improving surface irrigation by (gated pipes)	In furrow	8873.31	47525	5.36
	In beds	7995.9	49635	6.21
Aswan region				
Surface irrigation A1	In furrow	17622.09	47025	2.67
	In beds	14639.95	47975	3.28
Improving surface irrigation by (gated pipes)A2	In furrow	13205.2	49900	3.78
	In beds	11335.47	54560	4.81

3- Saving of irrigation time (minute / fed) and irragtion costs (l.E/fed)

Saving of irrigation time and irrigation costs as influenced by irrigation systems and planting methods were presents in Tables (3 and 4). The results of the Tables (3 and 4) show that (from view point of water and economic) when we use the best irrigation system A_2b_2 (gated pipes in beds) we can save irrigation time about 36.90 %, 37.95 and 38.19 % and saving of costs irrigation (oil and diesel) about 36.27 %, 34.04 %, 35.63 % for each region El Minia – Luxor– Aswan respectively compared with the conventional irrigation in region A_1b_1 (surface irrigation in furrow). From these results it could be concluded that the using gated pipe system in beds decreased irrigation time and irrigation costs which lead to reduction in the overall of production requirements for sugar cane crop compared with traditional irrigation method.

Table (3): Comparison between time saving of irrigation (minute / fed& %) under surface irrigation A_1b_1 with different treatments for sugar cane crop in the two studies seasons for each region.

Treatments	El-Minia region			Luxor region			Aswan region		
	Irrigation time (min/season)	Saving of irrigation time		Irrigation time (min/season)	Saving of irrigation time		Irrigation time (min/season)	Saving of irrigation time	
		(min/ season)	%		(min/ season)	min/season %		(min/season)	min/season %
Surface irrigation in furrow (common method in region)	**6417**	1219	19.00	**7115**	1323	18.59	**%9860**	1765	17.90
Surface irrigation in beds	**5198**			**5792**			**8095**		
Surface irrigation in furrow (common method in region)	**6417**	1764	27.49	**7115**	2027	28.49	**9860**	2870	29.11
Irrigation by gated pipes in furrow	**4653**			**5088**			**6990**		
Surface irrigation in furrow (common method in region)	**6417**	2368	36.90	**7115**	2700	37.95	**9860**	3766	38.19
Irrigation by gated pipes in beds	**4049**			**4415**			**6094**		

Table (4): Irrigation costs (L.E / fed& %) under surface irrigation A_1b_1 compared with different treatments for sugar cane crop in the two studies seasons for each region.

Treatments	El-Minia region			Luxor region			Aswan region		
	Irrigation costs (L.E/season)	Saving of irrigation costs (L.E/season)	%	Irrigation costs (L.E/season)	Saving of irrigation costs (L.E/season)	%	Irrigation costs (L.E/season)	Saving of irrigation costs (L.E/season)	%
Surface irrigation in furrow (common method in region)	510	93	18.24	570	104	18.25	870	156	17.93
Surface irrigation in beds	417			466			714		
Surface irrigation in furrow (common method in region)	510	128	27.41	570	147	25.79	870	220	25.29
Irrigation by gated pipes in furrow	370.20			423			650		
Surface irrigation in furrow (common method in region)	510	171	36.27	570	194	34.04	870	310	35.63
Irrigation by gated pipes in beds	325			376			560		

Irrigation machine used in the three areas has been standardized and are similar in disposition rate (4 inches)

4-The Economic Evaluation:

Total costs, production and total income (L.E / fed.)

Data in Table (5) show that values of total cost, production, total income (L.E / fed.) and net return from unit of irrigation water (L.E/ m^3) as influenced by irrigation systems and different planting methods of sugar cane in both studied seasons.

The maximum values of total income for each region El Minia, Luxor and Aswan obtained from plants which grow with gated pipes in beds (A_2b_2) were (20250, 19854 and 21824 L.E/fed), net profit were (6794.75, 4882.85 and 7957.5 L.E/fed) and return from a unit of irrigation water applied were (1.32, 0.79 and 1.06 LE / m3) for region El Minia, Luxor and Aswan regions respectively. While, the lowest values of total income obtained from A_1b_1 (conventional irrigation) were (18112, 17410 and 18810 L.E/fed), net profit were (4713.80, 3759.75 and 5546.88 L.E/fed) and return from a unit of irrigation water applied were (0.48, 0.31and 0.31 L.E/m3) for the same regions respectively.

From these results it could be concluded that the improving surface irrigation by gated pipes in beds lead to increase in total income, not profit and net return of irrigation water. The data in Table (5) show also that the highest values of yield for each region El Minia, Luxor and Aswan were (50.625, 49.635 and 54.560 ton/ fed) respectively were obtained from improving surface irrigation by gated pipes in beds. While the lowest values of yield were (45.280, 43.525 and 47.025) were obtained from surface irrigation in furrow (A_1b_1)) for the same region respectively. These results reflex how much irrigation water can be saved to produce the highest yield with least possible amount of water applied.

The economic efficiency data, presented in Table (5) for each region. From these results it could be concluded that the lowest values of economic efficiency were obtained from surface irrigation in furrow were (0.35, 0.28 and 0.42) for each Egyptian pound (L..E) spend for production for El Minia, Luxor and Aswan respectively while, the highest economic efficiency were(0.48, 0.33 and 0.57) obtained from improving surface irrigation by gated pipes in beds for the same regions respectively. These increases in economic efficiency due to the enhancement of net profit in the improving surface irrigation by gated pipes in beds compare with other treatments.

5-The economic benefits (LE/ area)

Data in Table (6) show that the values of financial benefits (L.E/ area) as a result of saving of water, yield, irrigation costs and irrigation time (L.E/ area). From these results it could be concluded that using the best method (improving surface irrigation by gated pipes in beds A_2b_2) get total of financial benefits (as a result of saving water + saving of yield + saving of irrigation time+saving of irrigation costs) were (806,146850 million, 966,325941.94 million and 1,342401456.98 Millar / area) for each region El Minia, Luxor and Aswan respectively.

Table (5): Average values of total costs, production, total income (L.E), net return per cubic meter a water (L.E /m3) and economic efficiency by different planting methods and system irrigation for sugar cane crop in the two studied seasons.

Treatments		The total costs (L.E)	Yield (ton /fed)	*Total return L.E / fed.*			*Water productivity L.E/m3*		
			Average total yield	Market price	Total income	Net profit	Water applied m3/fed	Net return from unit water applied L.E/m3	Economic efficiency
El Minia region									
Surface irrigation system (A1)	In furrow (b1)	13398.2	45.280	400	18112	4713.80	9919.10	0.48	*0.35*
	In beds (b2)	13316	47.125	400	18850	5534	8558.42	0.65	0.41
Gated pipes system (A2)	In furrow	13614. 25	47.700	400	19080	5465.75	7689.77	0.71	0.40
	In beds	13455.25	50.625	400	20250	6794.75	6692.76	1.02	0.48
Luxor region									
Surface irrigation system (A1)	In furrow (b1)	13650.25	43.525	400	17410	3759.75	11951.76	0.31	0.28
	In beds (b2)	13906.25	45.875	400	18350	4443.75	9916.38	0.45	0.32
Gated pipes system (A2)	In furrow	15079.15	48.225	400	19010	4210.85	8873.31	0.47	0.28
	In beds	14971.15	49.635	400	19854	4882.85	7995.9	0.61	0.33
Aswan region									
Surface irrigation system (A1)	In furrow (b1)	13263.12	47.025	400	18810	5546.88	17622.09	0.31	0.42
	In beds (b2)	13197.12	47.975	400	19190	5992.88	14639.95	0.41	0.45
Gated pipes system (A2)	In furrow	14258.5	49.900	400	19960	5701.5	13205.2	0.43	0.40
	In beds	13866.5	54.560	400	21824	7957.5	11335.47	0.70	0.57

Table (6): Total of economic benefits (L.E/ area) when using the best treatments (A_2 b_2 gated pipes in beds) and compare it with conventional method (A_1b_1) in different experimental regions in the two studied seasons

Treatments	Saving of water L.E / area						Saving of yield LE/area					Saving of irrigation time (L.E/are)				Saving of irrigation costs (oils + diesel) (L.E/ area)			
	Water applied (m3/fed)	Saving of water (m3/fed)	Average area cultivated sugarcane in Egypt fed/area	The total of water saving (m3 billion /area)	*The cost of transporting cubic meter water	(1)The total of water saving (million L.E/area)	Total yield (ton/fed)	Increase in yield (ton/fed	Market price ton/fed.	Saving of yield (L.E/fed.)	Saving of yield (million L.E/ area	The time irrigation/season (minute /feddan)	Time saving (minute / season)	total of finical benefits (L.E/fed.)	(3)total of finical benefits (L.E /area)	The cost fir each irrigation (L.E /irrigation)	Saving of irrigation costs L.E/ fed.)	(4)Total saving of irrigation costs (L.E/ area)	The total of finical benefits (L.E/area (1+2+3+4)
El Minia Region																			
Surface irrigation in furrow (A_1b_1) control	9919.10	3226. 34	317000	1022749780	0.037	37841741. 86	45.280	5.35	400	2140	678380000	6417	2368	232.05	73559850	510	171	54207000	806146850 million/area
Gated pipes in beds (A_2b_2)	6692.6						50.625					4049				325			
Luxor Region																			
Surface irrigation in furrow (A_1b_1) control	11951. 76	3995. 86	317000	1266687620	0.037	46867441. 94	43.525	6.11	400	2444	774748000	7115	2700	262.5	83212500	570	194	61498000	966325941.94 million/area
Gated pipes in beds (A_2b_2)	7995.90						49.635					4415				376			
Aswan Region																			
Surface irrigation in furrow (A_1b_1)control	17622. 09	6286. 62	317000	1992858540	0.037	73735765. 98	47.025	7.54	400	3016	956072000	9860	3766	366.1	116053700	870	310	98270000	1342401456. 98 Milliar/area
Gated pipes in beds (A_2b_2)	11335. 47						54.560					6094				560			

Resource: Egypt: study on cost Recovery in the irrigation and Drainage sector, Ministry of irrigation and water Resources (KFW.) September 2004

Conclusion and Recommendations

The improving surface irrigation by gated pipes in beds will started to be widely introduced in Egypt. So we have search for applicable solutions and how to limit the sugar cane consumption of water and keep the planted land as it is, and to expand the producing sugar from sugar beet in new lands. One of these solutions is the point of our study which study the effect of gated pipes in beds on water consumptive use and the water use efficiency for the crop in order to have a high yield and optimum economic returns with least quantities of water.

The results also indicated from the economic point of view, that highest values field water use efficiency (7.56, 6.21and 4.81 kg/m3) were obtained

using the treatment A_2b_2 (gated pipe in beds) in each region El Minia, Luxor and Aswan respectively.

The highest values of total income, production, financial benefits (L.E/ area), net return of each and water irrigation (L.E /m3) and economic efficiency were gained with it for all regions. Therefore, the economics of irrigation water becomes very important for planting irrigation management project where the over irrigation practices by farmers usually lead to low irrigation efficiency, water logging and high losses of water. So it could be recommended from view point of water and economic irrigated sugar cane crop by gated pipe system to produce high yield and increase economic returns with less amount of water apply under Egypt conditions.

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