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Effect of Reuse Agricultural Waste Water on Rice Yield, Water Needs and Efficiency

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Abstract. : In Egypt, the reuse of agricultural drainage water provides a great supplement to the fresh water supply. Government pumping stations (official) and farmers' small pumps (unofficial) lift water up from drains and direct it back into the irrigations canals for reuse in agriculture water supplies, as water passes through the soil, it absorbs salts leading to differences in the quality of drainage and irrigation water up to certain constrains limits. Therefore, mixing two water types enhanced the overall quality. The present study investigate the effect of reuse of agricultural drainage water on rice crop production, water needs and water use efficiency in KAFR EL SHEIKH Governorate. Field measurements of water and soil salinities were recorded during the study period. Five cases of different water mixes in irrigation of rice during the agriculture summer season to identify the effect of different irrigation water quality with different percentages of water mixes, The fresh water lifted from Meet yazeed canal (main canal) in KAFR ELSHEIKH Governorate, while the drainage water from private drain mixed with different ratios during summer season 2018 to identify its effect on rice production, water needs and soil environmental.

Keywords: Reuse, Agricultural, drainage, water quality, irrigation, efficiency, kafr-elsheikh, Egypt.

1. INTRODUCTION

In response to the increasing population and economic growth, water consumption will also increase and that will increase the competition for water demand between different sectors depending on water such as municipal, industrial, agricultural, environmental and recreational needs. If this trend continues with water withdrawal under the same practices and policies, by 2025 water stress will increase in more than 60 % (Cosgrove and Rijsberman, 2000).In this regard, securing food for the growing population is a major challenge where agriculture is considered the largest water consumer in most regions in the world. Using water resources for agriculture are always over used and misused, where agriculture water budget equals approximately 69 % of all water withdrawals, It is assumed that cultivated lands have to expand by 20-30 percent in area by 2025 in order to produce sufficient food for the growing population ,In order to prevent considerable food shortages, the productivity of water use should be increased, that means, the amount of food produced with the same amount of water needs to be increased. This possible through the reuse of drainage water (FAO, 2000). The rice crop is considered one of the most important crops in Egypt. The cultivated area is estimated at more than one million feddans annually in the north and central delta region. The average water needs of the feddan are estimated at 7 thousand m^3/sn, which is estimated at more than 7 BCM (Ashraf M.Elmoghazy, Mustafa M.Elshenawy,2018).

- **Water Resources and Water Demand in Egypt**

The main source of water in Egypt is the Nile River which supplies the country by approximately 97% of the annual renewable water resources. A share of the Nile River is about 55.5 BCM is allocated for Egypt according to Nile water agreement. This Agreement also allocates a share of 18.5 BCM to Sudan(1959), while about 10 BCM is lost in evaporation from the high dam reservoir lake Nasser (Wagdy A.2008). The other water resources are rainfall on the Mediterranean coastal strip decreasing eastward from 200 mm/year at Alexandria to 75 mm/year at Port Said, and decreasing to 25 mm/year near Cairo. The overall average annual rainfall in Egypt is about 1.3 BCM/Yr. The quantity of rainfall for year 2013/2014 was about 0.9 BCM. The total storage capacity of the Nile aquifer system is about 500 BCM (200 BCM in the valley and 300 BCM in delta), however, groundwater occurs at great depths and the aquifer is generally non-renewable. The utilization of such water depends on many factors such as pumping costs versus the potential economic return on the long run. The overall annual consumption from the Delta aquifer is about 6.7 BCM. Based on the previous data the overall annual water supply of water from the Nile River, rainfall, and ground water is approximately 63.1 BCM and various demands of fresh water are exerting excessive pressure on the available water supply such as the agricultural sector (including fish farms) is the highest fresh water consumer, utilizing about 62.25 BCM and 1.2 BCM respectively of the total natural supplies, The navigation and energy (i.e. hydropower) sub-sectors are " in stream " users, meaning that they utilize the Nile/irrigation distribution system, but they are not net consumers of the water resources, and evaporation loses from the Nile and canals is approximately 2.95 BCM/Yr (MWRI,2019).The previous data shoes that the overall annual supply of water from conventional water resources (the River Nile, ground water, and rainfall) is approximately 63.1 BCM, and annual demand equals approximately 76.21 BCM. In recent study prepared by Barnes,J.(2012) it was mentioned that Egypt uses 25% more than it already has, because Egypt's water is used multiple times on its journey through the country. The reuse of drainage water is one of the main reasons that Egyptians can use a larger volume of water than that flow into the country, where the agriculture drains discharge water back into the river, at multiple points through the drainage pumps to lift water from the drains and direct it back into the irrigation system for reuse. This drainage water provides an integral supplement to Egypt's water supply. But the problem is drainage water passes through the soil, villages and drainage network; it is picking up salts, sewage waste, agricultural chemicals, and other pollutants that make drainage water different in quality Barnes,J.(2012).Actions should be taken to maximize the non-conventional water resources especially agricultural drainage water, as drainage water is relatively cheap source and the total amount from drainage water approximately equals 15 BCM/Yr. This amount is collected through a surface and subsurface drainage network (Barnes J.,2014).

- **Salinization Problems and Drainage Management**

In many cultivated areas around the world, irrigation systems without sufficient drainage networks may lead to rising water table (water logging) and salinity problems. The development of irrigation systems increased the agricultural production, but that development has an adverse effect on soil characteristics and cultivated land where the seepage from the irrigation network and deep percolation from farm land accumulated in the groundwater lead to arise in water table. Often the drainage development didn't meet the improvement of irrigation system and drainage facilities have been neglected (Elgabaly M.M,1980).

Salinization problems affects about 20-30 million ha of the world's 260 million hectar of the cultivated land, that means 11.5 % of world's cultivated land suffer from Salinity problems (FAO, 2000). Implementation of drainage systems is very important to control soil salinity and maintain suitable conditions for crop growth. (Smedema, et, al.2000) estimated that the current drainage improvement programs cover less than 0.5 million ha per year, insufficient in their view to balance the growth of affected areas. It was estimated that (10-20) % of the irrigated land is already equipped with drainage,(20-40) % of the irrigated area is not in need of any artificial drainage, while (40-60) % of the cultivated land is in a need of drainage but remains without drainage facilities. In Egypt 37.3 % of the irrigated land is considered salinized area, and the percentage of area covered by surface and subsurface drainage is equal to 90.3 % (FAO, 1997). Cropping pattern along the canals indicates random cultivation of crops, as farmers are free to decide which crops to cultivate, the mixing ratio of saline backflow water is higher at the end of the branch canals, here better organized cropping pattern should be adopted based on the salt tolerance of each crop (Khater,2014).

- **Drainage Water Reuse Practices in Egypt**

There are three levels of drainage water reuse in Egypt. The first is called "official drainage reuse" this level of reuse is implemented through the government programs. The second level is called "unofficial drainage reuse level" which is practiced by farmers and water users according to the water deficit. The third level of reuse is called "intermediate drainage reuse level". This type of reuse is implemented by the local irrigation directories in their respective province jurisdiction. These levels of reuse differ from one region to another in terms of reuse pattern, quantity, and quality.

Ayman A., Abdelazim N.,(2013) discussed the suitability of drainage water reuse in irrigation by backflow from drains at the end of the irrigation canals in the north of the Nile Delta. Moreover, to assess the drainage water quality and its suitability for direct reuse in irrigation in this area. The analysis of the collected data on drainage water quality of the study area compared to the Egyptian standards for the drainage water reuse indicated that the drainage water quality does not meet the local standards for the direct reuse of drainage water in irrigation. It is recommended to apply in-stream treatment system or mixing the drainage water with fresh irrigation water for improving the drainage water quality to avoid the excessive deterioration of drainage water, soil and plant productivity.To avoid the future deterioration in the drainage water quality a detailed study is urgently required to identify the pollution sources for the drainage water and to define the appropriate pollution control measures. It is recommended to apply an in-stream treatment system at the end of the canals which feeds by drainage water by back flow from the nearby drains. Moreover, an integrated reuse plan that includes the recommended mixing locations and ratios should be identified for the study area to overcome the shortage in the irrigation water at the end of irrigation canals.

A. El-Sayed and M. Shaban,(2018) Developed a tailor made water quality index for assessing agricultural drainage water that can be reused for irrigation using water quality program collected within the frame work of the Egyptian National Water Quality Monitoring Program executed partially by the DRI.

Hany Abdelhamid,(2017) discussed Egypt's current situation of water supply and uses, to analyze the quantities of generated waste water and treated waste water, to highlight the main problems related to the use of waste water in Egypt, furthermore, the safe reuse of treated waste water for agriculture and related laws and regulations and found that Reuse of treated waste water and drainage water in agriculture under proper agronomic and management practices has many economic benefits, which include alleviating freshwater scarcity, providing a drought resistant source of water and nutrients, which reduce the fertilizer costs, increase water productivity by cultivation of multiple crops through the year, and confers environmental benefits. However, variability in composition of wastewater causes risks to soil, ecosystems, plants, animals and human beings. The control of pollution in agricultural drains could be achieved just after the discharge points using in-situ submerged bio filters and self-RBC, which accelerate the biodegradation rate of organic contaminant resulting in improvement of stream self-purification capacity and enhance the water quality for safe reuse.

J.Barnes/Geoforum (2014) drew attention to explore how drainage water reuse shapes the quality and quantity of Egypt's water in space and time with profound consequences for farmers who rely on that water for their livelihood. Irrigation managers commonly cite a mixing ratio of one to one as a"rule of thumb". Ateam of Egyptian scientists from the ministry's water research center conducted found that in the light of the high salinity of drain age water amixing ratio of 5:1 of canalto drainage water would be necessary to generate water suitable for irrigation **(Gammal and Ali,2011)**.

2.Description of Experimental Field Work

In this regard we will present the steps of the experiment:

- **Location of The Study Area**

Afield and experimental works were conducted during summer season of 2018 at El Karada (serves about 4 feddan) water requirements research station, Kafr El sheikh governorate water management and irrigation system research institute, national water research center, Egypt, Fig.(1).

Fig.1 Location from GPS

- **Soil Analysis**

  Soil Sample were taken from depths (0-20),(20-40) and (40-60) cm respectively before planting to determine the physical and chemical properties of the experimental soil salinity according to dewis and fartios (1970) and Jackson (1967).

- **Water Analysis**

  Water samples (irrigation and drainage water) were collected during irrigation, those samples were analyzed to study their suitability for irrigation through the season and were determined according to to Richards (1954). The values of Ec and SAR (Sodium Adsorption Ratio) were calculated.

- **Agricultural Practices**

  Rice crop variety Giza 179 was planted on 1 may and harvested on 13 September.

- **Experimental Field Design**

  The experimental design includes five irrigation cases arranged in randomized complete block design with three replicates for 5 areas as explained in red Fig.2.

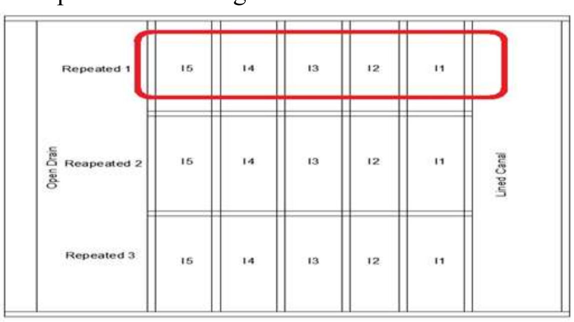

Fig.2 Sketch of field Design

- **Statistical Analysis**

  Data obtained from field measurements were subjected to the analysis by excel sheets.

- **Basic Treatments**

  The irrigation water included five water qualities as follows:

  - The first case, in which the Fresh irrigation water from canal was used only in irrigation requirements Whole the season
  - The second case, in which One canal irrigation water (fresh water) was mixed with one drainage irrigation water Whole the season.
  - The third case, in which One canal irrigation water (fresh water) was mixed with two drainage irrigation water Whole the season.
  - The fourth case, in which One canal irrigation water (fresh water) was mixed with three drainage irrigation water Whole the season.
  - The fifth case, in which the Drainage irrigation water from drain was used only in irrigation requirements Whole the season.

- **Irrigation Water Measurements**

  The irrigation water applied was measured by using a rectangular sharp crested weir, its width equals 0.30 m which was calibrated.
  The discharge was calculated using the following equation: $Q=0.502H^{(1.56)}$.

  Where:
  Q = the discharge (m^3/s).

  H = the head of of water of the crest (m).

  The study area is irrigated with mixed fresh water from meet-yazeed canal and drainage water from private drain, water from canal passes through water smoothing ponds to calm water coming from main canal (meet-yazeed) and passes through crested weir, irrigation water was measured by using a rectangular sharp crested weir. Through the equations above, head of water was measured every time and get discharges (m^3/s.

3. Determination of Salinity in the Study Area

Cultivation areas surrounding tail ends of branch canals in Kafr El-Sheikh Governorate suffer from shortage in irrigation water supply from Nile River. Moreover, ground water is highly saline in Kafr El-Sheikh Governorate, which makes it difficult to use in agriculture, Khater et al., (1997) found that the values of electrical conductivity (EC) for ground water varies from location to another and high especially for areas using mixed water. And in this research calculated values of electrical conductivity of soil, Drainage water and irrigation water observed as following.

3.1 Irrigation Water Salinity

Table (1) shows the irrigation water analysis during months of the experiment where Ec on may was .44 (ds/m) equals 208.12 (µmhos/cm, its at zone of low salinity (class1,Excellent) and on September .37 (ds/m) equals 175 (µmhos/cm) at low salinity zone (class1,Excellent).

Table (1) Irrigation water analysis during months of the experiment

Date	Ec (ds/m)	PH	cation (meq/L)				Anion (meq/L)			
			ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
May	0.44	7.8	1.26	1.4	1.78	0.23	0	2.3	1.12	1.25
June	0.384	7.68	1.85	1.21	0.9	0.11	0	0.8	2.8	0.4
July	0.415	7.73	1.86	1.23	0.95	0.12	0	0.85	2.9	0.41
Aug.	0.4	7.79	1.6	1.5	0.85	0.15	0	0.95	2.87	0.28
Sep.	0.37	7.8	1.6	1.41	0.75	0.14	0	0.9	2.8	0.2

3.2 Drainage Water Salinity

Table (2) shows the drainage water analysis during 5 months of the experiment where Ec on may was 0.66 (ds/m) equals 312.18 (µmhos/cm) , it is at zone of medium salinity (Class 2,Good) and increase during months of the experiment until it reached 2.25 (ds/m) equals 1064.25 (µmhos/cm) at high salinity zone (Class 3, Permissible[1]).

Table (2) Drainage water chemical analysis during months of the present study

Date	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
			ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
May	0.66	8.4	4	0.56	1.83	0.26	0	1.8	1.7	3.24
June	0.65	8.5	4.2	0.66	1.8	0.26	0	1.7	1.65	3.57
July	1.4	8.4	3.85	2.55	7	0.8	0	1.5	5.9	6.8
Aug.	1.9	8.5	4	3.5	11.2	0.9	0	1.5	8.8	9.3
Sep.	2.25	8.5	4.1	6.8	12.5	1.1	0	2.5	10	10

3.2 SOIL SALINITY

Table (3) shows the soil chemical analysis calculated at different depths as shows, the value of Ec is located at zone very slighty saline so crop is very sensitive to be restricted. the values of SAR eqauls = 4.53, 4.27 and 4.91. it is at zone normal.

Table (3) Soil Chemical Analysis at different depths Before agriculture

	Soil depths	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
				ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
before agriculture	0-20	2.45	8	8.5	7.2	12.7	0.6	0	13.2	11.3	4.5
	20-40	3.45	8.1	10.4	8.1	13	0.75	0	11	15	6.25
	40-60	3.55	8.1	11.3	9.9	16	0.9	0	12	16.5	9.6

Table (4) shows the soil chemical analysis calculated at different depths **first case** in which the Fresh irrigation water from canal was used only in irrigation requirements as shows, the value of Ec is located at zone very non-saline so salinity affects mostly negligible. the values of SAR equals 4.43, 4.92 and 4.55. for the depths respectively it is at zone normal.

Table (4) Soil chemical analysis at different depths first case

	Soil depths	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
				ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
Case 1	0-20	1.45	8.05	4.3	3.5	8.75	0.45	0	6.35	4	6.65
	20-40	1.65	8.1	4.5	3.6	9.9	0.49	0	6.5	4.2	7.79
	40-60	1.65	8.15	4.55	3.7	9.25	0.5	0	6.6	4.3	7.1

Table (5) shows the soil chemical analysis calculated at different depths **second case** in which One canal irrigation water (fresh water) was mixed with one drainage irrigation water as shows, the value of Ec is located at zone very slightly saline so crop is very sensitive to be restricted. the values of SAR equals 5.56, 5.8 and 5.77. for the depths respectively it is at zone normal.

Table (5) Soil chemical analysis at different depths second case

	Soil depths	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
				ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
Case 2	0-20	2.35	7.77	5.45	5	12.7	0.5	0	6.5	5.5	11.65
	20-40	2.7	7.8	6.5	6	14.5	0.55	0	7	6.7	13.85
	40-60	2.75	8	6.55	6.1	14.5	0.55	0	7.1	6.8	13.8

Table (6) shows the soil chemical analysis calculated at different depths **third case** in which One canal irrigation water (fresh water) was mixed with two drainage irrigation water as shows, the value of Ec is located at zone very slightly saline so crop is very sensitive to be restricted. the values of SAR equals 4.58, 4.62 and 5.78. for the depths respectively it is at zone normal.

Table (6) Soil chemical analysis at different depths third case

	Soil depths	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
				ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
Case 3	0-20	2.48	7.8	8.55	7.3	12.9	0.4	0	7.5	6.7	14.95
	20-40	2.98	7.6	9.4	8.7	13.9	0.5	0	9	13.5	10
	40-60	3.1	7.95	7.95	6.8	15.7	0.56	0	9.1	13.8	8.11

Table (7) shows the soil chemical analysis calculated at different depths **fourth case** in which One canal irrigation water (fresh water) was mixed with three drainage irrigation water as shows, the value of Ec is located at zone very slightly saline so crop is very sensitive to be restricted. the values of SAR equals 5.91, 6.36 and 5.597. for the depths respectively it is at zone normal.

Table (7) Soil chemical analysis at different depths fourth case

	Soil depths	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
				ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
Case 4	0-20	2.9	6.8	7.3	6.1	15.3	0.5	0	9	12.5	8
	20-40	3.4	7.5	8.6	7.4	18	0.55	0	9.5	13	12.05
	40-60	3.8	7.9	10.9	9.1	17.7	0.8	0	10.5	14	13.6

Table (8) shows the soil chemical analysis calculated at different depths fifth case in which the Drainage irrigation water from drain was used only in irrigation requirements as shows, the value of Ec is located at zone very slightly saline so crop is very sensitive to be restricted. the values of SAR equals 4.45, 4.57 and 5.25. for the depths respectively it is at zone normal.

Table (8) Soil chemical analysis at different depths fifth case

	Soil depths	Ec (ds/m)	PH	Cation (meq/L)				Anion (meq/L)			
				ca^{++}	Mg^{++}	Na^{+}	K^{+}	co_3^{--}	Hco_3^{-}	Cl^{-}	So_4^{--}
Case 5	0-20	3.2	6.9	9.6	8.8	13.5	0.8	0	6.6	15.8	10.3
	20-40	3.3	7.3	9.8	9	14	0.95	0	6.7	16	11.05
	40-60	3.95	7.7	10.7	11.8	17.6	1.1	0	11	18.5	11.7

3.Remedial Solutions to Reduce Drains Water Salinity

- **Mixing With Fresh Irrigation Water With Suitable Ratios**

The most appropriate and cheapest solution to reduce drainage water salinity is the mixing with fresh irrigation water by a certain value. As shown in **table (9),** the ministry of Water Resources and Irrigation installed many mixing pump stations in different locations to reuse the drainage water and this amount of water is considered source of Egypt budget.

Table (9) Quantities of water added to various cases.

No.	Cases	Quantities of Fresh irrigation water (m^3/Fed)	Percent %	Quantities of drainage water (m^3/Fed)	Percent %	Amounts of water added (m^3/Fed)
1	Fresh irrigation water	6003	100	0	0	6003
2	Fresh irr. + Drainage irr.(mutually)	2944	50	3002	50	5946
3	Fresh irr. +2 Drainage irr.(mutually)	2254	36.98	3754	63.02	6008
4	Fresh irr. +3 Drainage irr.(mutually)	1614	29.92	4384	70.08	5998
5	Drainage irr.	0	0	6048	100	6048

5. The Effect of Reuse Agricultural Drainage Water on Rice Crop Productivity

Low water quality as well as water shortage results in low productivity of agricultural land. From table (10) it is clearly observed that the agriculture production goes down, the rice production was 3.9 ton/fed. At 2015 where at 2018 became 3.395 ton/fed. When irrigated with mix of drainage water and fresh water (case 4) and 3.064 ton/fed. When irrigated with direct drainage water only(case 5).the following figure (3) shows the Relation between Quantities of water added (m3/fed) and productivity of rice crop (kgm/fed.).

Table (10) Quantities of water added (m3/fed) to various cases, Rice crop productivity

No.	Cases	Amounts of water added (m^3 / Fed)	Crop Productivity (kgm/Fed)
1	Fresh irrigation water	6003	4310
2	Fresh irr. + Drainage irr.(mutually)	5946	4263.3
3	Fresh irr. +2 Drainage irr.(mutually)	6008	3575
4	Fresh irr. +3 Drainage irr.(mutually)	5998	3394.6
5	Drainage irr.	6048	3064

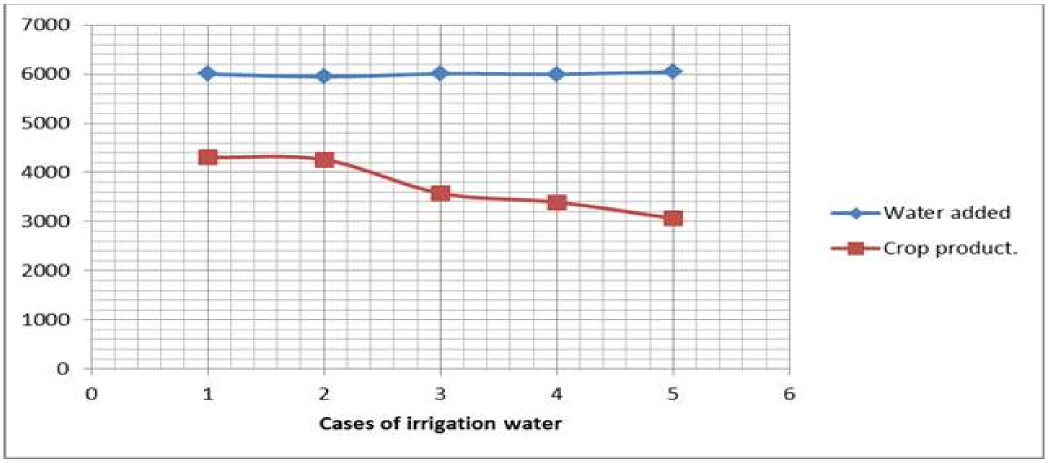

Fig. (5-10) The Relation between Quantities of water added (m3/fed) and productivity of rice crop (kgm/fed.).

6. The Effect of Reuse Agricultural Drainage Water on Water Needs and Irrigation Productivity

The following table shows the results of crop productivity and water needs of the crop, the results tend to lower when using direct drainage water and increase when mixed with fresh one. And this helps to compensate the lack of water by reusing through mixing and achieving the best benefit.

Table (11) Quantities of water added (m3/fed) to various cases and Water productivity (kg/m3)

No.	Cases	Amounts of water added (m^3 / Fed)	Crop Productivity (kgm/Fed)	Irrigation water Productivity (kgm/m^3)*10^{-3}
1	Fresh irrigation water	6003	4310	717.97
2	Fresh irr+1Drainage irr.(mutually)	5946	4263.3	717
3	Fresh irr.+2Drainage irr.(mutually)	6008	3575	595.04
4	Fresh irr. +3 Drainage irr.(mutually)	5998	3394.6	565.96
5	Drainage irr.	6048	3064	506.61

7. Conclusions

- Due to the construction of the Ethiopian Renaissance Dam and near completion, this will cause the reduction of Egypt's annual quota, which necessitates the reuse of agricultural drainage water again in irrigation.
- It was cleared that case 2 (1Fresh irrigation water+1 Drainage water) is the best mix as crop productivity in this case is 4263.3 (Kgm/fed.) which is so close to crop productivity in case 1 (Fresh irrigation water only) which gives productivity 4310 (Kgm/fed).
- Irrigation with direct drainage water leads to increase soil salinity in the study area and the unit yields of Rice crops in Kafr El-sheikh tend to lower due to Shortage in irrigation fresh water supply.
- There is a lack of productivity of feddan due to the use of mix water due to loaded salts.
- Rice productivity was reduced by increasing the amount of drainage water compared to that of fresh irrigation water, this decrease was evident when using only drainage water for irrigation, the percentage decreasing was about 29% when using drainage water compared to fresh irrigation water.

- For the average share of the unit of water in the production of the rice crop, it was found that the fresh irrigated feddan achieved the highest average production of the aquatic unit, followed by the irrigated feddan with blended water, the least of which was the unit used in irrigation from agricultural drainage water.

- **Recommendations For Further Works**

It is recommended that:

1. Water pollution should be taken in consideration for further works.
2. The use of fresh irrigation water mixed with agricultural drainage one, with providing a good and integrated agricultural drainage network so as not to be contaminated with industrial or sewage water.
3. Not to expand the use of direct agricultural drainage water, especially for rice crops(the study sample), which do not have the ability to withstand the high salinity levels and need a larger number of irrigation, which achieve low economic returns
4. Raise awareness for farmers through agricultural, environmental and health extension programs in the areas where agricultural drainage water is used for irrigation, and the economic importance of using modern irrigation methods such as drip irrigation, irrigation and improving soil properties by adding agricultural gypsum and tillage under soil.
5. Studying the effect of mixing water along term on environment and human.
6. Studying determine the best proportions of mixing water on feddan productivity of crops.
7. Study the extent of changing cultivation patterns on mixing ratios.

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تاثير اعادة استخدام مياه الصرف الزراعى على انتاجية محصول الارز والاحتياجات المائية وكفاءة استخدام المياه

يتناول هذا البحث دراسة تاثير اعادة استخدام مياه الصرف الزراعى على انتاجية محصول الارز والاحتاجات المائية وكفاءة استخدام المياه بكفر الشيخ حيث تبلغ حصة مصر من الموارد المائية حوالى 59.2 مليار م3 سنويا بينما تستهلك حوالى 76.9 مليار م3, مما يعنى ان مصر تستخدم حوالى 29 % زيادة عن حصتها الطبيعيه ونظرا لبناء سد النهضة الاثيوبى والذى على وشك الانتهاء وبالتالى ستقل حصة مصر من المياه بنسبة كبيرة فى سنوات بدأ الملأ والتخزين لذلك كان علينا ايجدا طرق بديلة لحل مشكلة المياه ومنها اعادة استخدام مياه الصرف الزراعى والذى نتناول دراسنه فى هذا البحث ويتم ذلك عن طريق اختيار خمس مواقع يتم ريها الأولى بمياه رى عذبه والثانيه والثالثه والرابعه بمياه رى مخلطه والخامسه بمياه صرف مباشر وتم دراسة الخصائص الكيميائية لمياه الرى والصرف والتربه معمليا وحسابEc & PH ونسب الايونات والكاتيونات كما موضح بالبحث خلال اشهر التجربه والتى كانت من شهر مايو الى شهر سبتمبر وقت الزراعه واتضح من نتائج الدراسه ان الرى بمياه صرف مباشرة تؤدى الى ملوحة التربه ومنه خفض نسب انتاجية المحصول وان متوسط انتاج الفدان الواحد عند الرى بمياه رى عذبه يحقق اعلى متوسط انتاجيه عنه عند استخدام مياه الصرف المباشر وان الاحتياجات المائية (انتاجية المياه) عند استخدام مياه الرى العذبه تحقق اعلى انتاجية عنه عند استخدام مياه الصرف المباشر لذلك اتضح انه ينبغى خلط مياه الصرف والرى بنسب مختلفه لحل هذه المعادله ولا يتم استخدام مياه الصرف المباشر حيث تزيد ملوحة التربه وتقل الانتاجية وذلك لنتائج افضل.