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INVESTIGATING THE POTENTIAL OF AGRICULTURAL DRAINAGE WATER AS IRRIGATION SOURCE FOR EARTHEN FISH PONDS

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Abstract

The potential of using agricultural drainage water for earthen fish ponds irrigation has been investigated through evaluating its influence on different limnological aspects in comparison to fertilized fresh water. Two sets, each of three earthen ponds were used. The obtained results showed significant differences in most tested water characteristics (water visibility, pH, total alkalinity, total hardness, total ammonia, un ionized ammonia and nitrate) between the two investigated treatments in where there were no significant effects on temperature, dissolved oxygen (DO), and ortho phosphates (OP). Phyto and zooplankton assessment recorded a marked increase in their abundance in drainage water treatment. Phytoplankton community composition varied between the two treatments where green algae, the most useful taxonomic division dominated the other divisions in drainage water treatment, while blue green algae dominated the other divisions in fresh water treatment. With respect to zooplankton community composition, Cladocera and Rotifera dominated the other species in agricultural drainage and fresh water treatments respectively. Upon the obtained results utilizing agricultural drainage water for irrigating fish ponds could be recommended.

INTRODUCTION

Aquaculture is considered as one of the most important sources of animal protein production for meeting the world's increasing demand for protein. The need to realize the maximum yield of all useable resources for food production is vital for over populated countries such as Egypt.

This may be partly achieved by increasing the production of fish. This increase can be realized by increasing the area of cultured ponds and optimizing aquaculture methods (Magouz *et al*., 1999).

The expanding population of Egypt creates an ever-growing pressure on the government to provide for new land reclamation areas. At the same time public water supply and industrial water requirements are increasing at the expense of agricultural water use. All these developments resulted in the recent past to adopt a strategy to reuse drainage water for irrigation on strategic locations where the drainage water is of sufficient quality to be mixed with irrigation water for downstream use. This reuse of drainage water complicates management and planning of water distribution, but certainly is a fast and cheap way to improve the overall efficiency of water use in the Nile Delta. Rowest (1998).

The potential of waste water fed aquaculture has long been recognized in Asia, and the history of such systems goes back over several centuries (Chan *et al*., 1993).

East Calcutta Wetland (ECW) is a perfect example of wise-use wetland ecosystem where usage of city sewage for traditional practices of fisheries and agriculture is practiced. The wetland ecosystem is a rare example of combination of environmental protection and development management. ECW also happens to be the largest ensemble of sewage fed fish ponds in the world in one place (Ray *et al*., 2007; Ray *et al*., 2008).

In Egypt, The annual average volume of available drainage water is about 14 thousand million m3 the policy of the ministry of water resources and irrigation is to make full use of each drop of drainage water by the year 2017, intensive research programme together with field experiments have been carried out for reusing agriculture drainage water. Monitoring and evaluation program are under continuous developments on a well- established research base. Guidelines for optimal use of drainage water and setting up strategies for reuse, under the Egyptian conditions have been delivered. (El-Gamal, 2007).This work aimed to investigate the potential of agricultural drainage water usage for fish ponds irrigation as reflected on different water quality characteristics, as well as phyto and zoo plankton abundance and community composition.

Materials and Methods:

This study was conducted at the Central Laboratory for Aquaculture Research (CLAR), and The World Fish Center at Abbassa, Abu Hammad, Sharkia governorate, Egypt from August (2010) to January (2011). Two different management techniques were investigated for the most potential one for aquaculture through its impact on different physical, chemical and biological characteristics of pond water.

Experimental ponds and area:

Six earthen fish ponds were used each of them has a total area of one feddan (4200 m^2) with a water depth of about 0.9 m and a total water volume of about 3780 m^3.

Experimental design:

Ponds were divided randomly into two different treatments, three replicates of each. First group of ponds which located in The World Fish Center were supplied from Gaddon canal water source which is a branch of Ismailia irrigation canal. This group of ponds received 300 kg/feddan/week chicken manure. The second group of ponds was supplied from El-Bahnasawy drain which is agricultural drainage water. All fish in the two treatments (*Oreochromis niloticus*, with stocking density of 3 fingerling/m^3) were fed with 25 % protein fish feed with a rate of 3% of bio mass/day. Water depth for each pond was maintained constant along the study period, where water loss due to evaporation or seepage was compensated through irrigation pipe, covered with a screen to prevent the entrance of wild fish.

Water quality measurements:

Different physical and chemical properties were carried out biweekly.

Outdoor measurements:

Water quality measurements taken outdoor:

-Temperature and dissolved oxygen (DO) using Yellow Spring Instrument (YSI model 57) oxygen meter.

-pH values using pH meter (model Corning 345).

-Water visibility using Secchi disk (SD).

Laboratory analysis

2 liters water collected from signed sites in each pond was mixed and transferred to the laboratory for the following measurements:

Total alkalinity and total hardness were determined by titration as CaCO3 according to APHA (1985).

Total ammonia concentration was determined by nesslerization method (APHA, 1985), and then Unionized ammonia (NH_3) was calculated through a coefficient related to water pH and temperature measured at the time of taking the sample, according to Boyd (1990):

Nitrate-nitrogen was measured by phenoldisulphonic acid method using spectrophotometer (model, WPA Linton Cambridge UK) as desribed in APHA (1985).

Filterable orthophosphate was measured by ascorbic acid method and measured by spectrophotometer (WPA Linton Cambridge UK) according to APHA (1985).

Biological examinations:

Phytoplankton assessment:

Phytoplankton was concentrated by settling 500 ml water sample in a volumetric cylinder for 7 days after being preserved in lugol's solution, at a ratio of 7 ml/liter sediment (APHA, 1985). The surface water was siphoned and the sediment was examined. Phytoplankton cells were identified to four divisions: Green algae (*Chlorophyceae*), Blue-green algae (*Cyanophyceae*), Diatoms (*Bacillariophyceae*), and Euglena (*Euglenophyceae*). Phytoplankton cells were counted microscopically in a special counting chamber using a micrometer eye lens.

Zooplankton assessment:

Ten liters of water were collected and filtered through a plankton net with a mesh size of 80 um and the sediment was preserved in 5% formalin solution at a ratio of 3% of filtrate. The organisms of zooplankton were identified to four divisions, which are: *Rotifera*, *Cladocera*, *Copepoda*, and *Ostracoda*. Their identification was carried by using Sedgewick Rafter Counting Cell and microscope (model Bausch & Lomb 31-74-24).

Statistical analysis:

Average values of different investigated parameters in both tested treatments had been calculated along the culture season. One-way ANOVA was employed to find the significance for each investigated parameter according to Bailey (1982). The significance was set at 0.05.

RESULTS AND DISCUSSIONS

Physico-chemical parameters of water play a significant role in the biology and physiology of fish (Dhawan and Kaur, 2002).Obtained results along the study period of different physicochemical characteristics were summarized in Table 1.

Water temperature:

Recorded data along the study period revealed that there were significant ($p<0.05$) differences in water temperature among different months in both treatments. Recorded results revealed that the highest water temperature in both treatments were during august and start to decrease during the followed months until the end of the study, were the lowest water temperatures were during December and January in both treatments. With the exception of September and January, there were no significant differences in water temperature degrees between the two treatments. Water temperature in fresh water treatment ranged between 16.72 and 28.5℃ while in drainage water treatment ranged between 17.29 and 28.42℃. All recorded water temperatures along the study period in both investigated treatments were within the optimum range of tilapia tolerance (24 -32 °C) mentioned by El-Sayed and Kawanna (2008).

Water visibility:

Concerning Secchi disk readings, obtained data revealed that there were significant ($P<0.05$) differences among its readings either among different months or between the two treatments. The lowest reading in fresh water treatment was during November, while for drainage water, the lowest reading was during October. Except during November, SD readings in fresh water treatment were significantly ($P<0.05$) higher than its readings in drainage water. Secchi disk value in fresh water treatment ranged between 8.1667 and 15 cm, while in drainage water treatment ranged between 5.333 and 10 cm. All recorded values were below the appropriate Secchi disk visibility for Tilapia, recommended by (Boyd, 1990) which ranged between 20 and 40 Cm. This result could be attributed to the increased abundance of phytoplankton in these treatments. Similar results were mentioned by El-

Naggar *et al* (2008) who reported that the increased phytoplankton abundance decreases Secchi disk reading in fertilized earthen ponds.

pH:

Obtained data revealed that pH values among different months in both treatments were significantly ($P<0.05$) different. The lowest pH values in both treatments were recorded in January while the highest were in November and August in fresh water and drainage water treatments, respectively. ALL pH values recorded in drainage water treatment among different months were significantly ($P<0.05$) higher than its values in fresh water treatment. pH values in fresh water treatment ranged between 8.511 and 8.98 and ranged between 8.81 and 9.4 in drainage water treatment. The decreased water visibility in agricultural drainage water treatment could be attributed to the increased phytoplankton growth in these ponds. Padmavathi and Prasad (2007) indicated that high pH levels in pond water are associated with algal blooms. Osman *et al.* (2010) reported that the pH at which dense algal blooms observed was 9.2 – 9.4.

Dissolved oxygen (DO):

Obtained data revealed that DO values recorded in September in both treatments were significantly ($P<0.05$) higher than its values in other months. There were no significant differences between dissolved oxygen values in both treatments except during October where the recorded value in drainage water was higher than that in fresh water treatment. The highest DO values in both treatments were recorded in September, while those values recorded during August in both values were considered of the lowest values along the study period. These values could be explained with regard to the observations of total phytoplankton count were the highest and the lowest count in both treatments were during September and August, respectively. Dupree and Huner (1984) mentioned that phytoplankton are the major source of dissolved oxygen in fish Ponds.

Boyd (1982) reported that an algal bloom must be maintained in fish ponds to improve oxygen levels. Dissolved oxygen values in fresh water treatment ranged between 7.8 and 8.53 mg/l while in drainage water treatment ranged between 8.2 and 8.63 mg/l. These concentrations could be considered most suitable for fish culture according to Bwala and Omoregie (2009) who reported that the desirable concentration of dissolved oxygen for most fish is 5 mg/l and above. Davies *et al*. (2006) reported that levels of dissolved oxygen ranged between 3 and 5.9 mg/l were desirable for phytoplankton growth and also for fish production.

Total alkalinity (T. ALK.):

Data showed that T.ALK. value recorded during August was the lowest in both treatments. It's revealed from the same table that total alkalinity values in drainage water treatment during different months were significantly ($P<0.05$) higher than its values in fresh water treatment, except during September where there were no significant differences. These values in fresh water treatment ranged between 375 and 512.5 mg/l and between 420.83 and 691.67 mg/l. Increased values of total alkalinity in agricultural drainage water treatment could be explained by the release of CO_2 from manure decomposition which act to dissolves calcium and magnesium carbonate present in pond sediment as mentioned by many authors (Kumar *et al*., 2005; Knud-Hansen, 1998 and Boyd, 1990).

Total hardness (T.H.):

Recorded total hardness values along the study period showed that there were significant ($P<0.05$) differences among its values during different months in both treatments. The highest were recorded during December, while the lowest were during August, in both treatments. It's observed also that its values in fresh water treatment were significantly ($P<0.05$) higher than those recorded in drainage water treatment among different study months. These increased values of total hardness in fresh water treatment in comparison to its values in drainage water treatment could be attributed to the increased total count of phytoplankton in drainage water treatment which resulted in the precipitation of $CaCO^{-}_3$, and consequently the reduction of total hardness as revealed by Knud-Hansen (1998).

Total ammonia (NH_4 + NH_3):

Total ammonia concentrations recorded in fresh water treatment along the study period ranged between 0.56 and 1.306 mg/l, with a gradually increase with time were the significantly ($P<0.05$) lowest value was during August while the significantly ($P<0.05$) highest were during January. Concerning drainage water treatment, the significantly ($P<0.05$) lowest total ammonia concentration (0.63 mg/l) was recorded during August while the significantly ($P<0.05$) highest (2.7167 mg/l) was during October. There were no significant differences in total ammonia values between the two tested treatments during the first three months, wile during the last three months, its values in drainage water treatment were significantly ($P<0.05$) higher than its values in fresh water treatment. It could be observed that total ammonia concentrations in both treatments increased in the last three months of the study which could be explained with regard to phytoplankton growth which decreased during these months. Osman *et al*. (2010) who reported that the increased photosynthetic and biological activities in larger ponds consumed much higher amounts of ammonia as micronutrient.

Table 1: Mean ± standard error of different physicochemical characteristics in the two investigated treatments alongside the study period.

		August	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**
Temp.	**F**	28.5± 0.183^{Aa}	27.633± 0.175^{Aa}	25.75± 0.793^{Ba}	20.15± 0.081^{Ca}	17.83± 1.447^{Da}	16.72± 0.168^{Db}
	D	28.42± 0.24^{Aa}	26.08± 0.49^{Bab}	25.15± 0.85^{Ba}	19.7± 0.55^{Ca}	17.33± 1.0541^{Da}	17.29± 0.33^{Dab}
SD	**F**	15± 0.26^{Aa}	14.17± 0.65^{Aa}	9.53± 0.24B^{Ca}	8.17± 1.05^{Ca}	8.75± 0.25^{BCa}	10.58± 0.82^{Ba}
	D	10± 0.00^{Ab}	8.58± 0.201^{Bb}	5.33± 0.21^{Db}	6.67± 0.76^{Ca}	7.5± 0.22^{Cb}	7.17± 0.31^{Cb}
pH	**F**	8.93± 0.04^{Ab}	8.65± 0.02^{BCb}	8.6± 0.13^{BCb}	8.98± 0.05^{Ab}	8.8± 0.052^{ABb}	8.51± 0.059^{Cb}
	D	9.4± 0.052^{Aa}	8.98± 0.065^{Ba}	8.92± 0.083^{Ba}	9.3± 0.086^{Aa}	9.00± 0.00^{Ba}	8.81± 0.068^{Ba}
DO	**F**	7.8± 0.137^{Ba}	8.53± 0.042^{Aa}	7.9± 0.113^{Bb}	8.13± 0.209^{ABa}	7.95± 0.143^{Ba}	8.26± 0.174^{ABa}
	D	8.2± 0.127^{Ba}	8.63± 0.131^{Aa}	8.33± 0.084^{ABa}	8.45± 0.081^{ABa}	8.2± 0.161^{Ba}	8.2± 0.109^{Ba}
T.Alk.	**F**	375± 12.97^{Bb}	466.67± 20.07^{Aa}	500± 15.81^{Ab}	495.83± 11.93^{Ab}	512.5± 8.54^{Ab}	472.78± 32.405^{Ab}
	D	420.83± 8.6^{Da}	516.67± 15.37^{Ca}	610± 15.55^{Ba}	651.67± 8.33^{Aa}	691.67± 16.67^{Aa}	686.11± 15.09^{Aa}
TH	**F**	206.67± 4.22^{Ea}	228.33± 4.01^{Da}	239.67± 5.81^{Da}	273± 5.39^{Ba}	300.67± 1.98^{Aa}	256.67± 6.24^{Ca}
	D	181± 3.22^{Eb}	196.33± 10.65^{DEb}	211.67± 4.01^{CDb}	240± 3.65^{Bb}	261.67± 9.1^{Ab}	221.11± 6.11^{BCb}
T.Am	**F**	0.56± 0.052^{Da}	0.85± 0.052^{Ca}	0.933± 0.067^{BCa}	1.2± 0.078^{Ab}	1.117± 0.086^{ABb}	1.306± 0.087^{Ab}
	D	0.633± 0.042^{Ba}	0.933± 0.042^{ABa}	2.717± 1.637^{Aa}	1.533± 0.096^{ABa}	1.7± 0.086^{ABa}	1.6± 0.078^{ABa}
NH_3	**F**	0.214± 0.022^{Bb}	0.185± 0.011^{Bb}	0.215± 0.062^{Ba}	0.35± 0.048^{Ab}	0.213± 0.045^{Bb}	0.123± 0.021^{Bb}
	D	0.402± 0.041^{Ba}	0.353± 0.019^{Ba}	0.362± 0.074^{Ba}	0.693± 0.099^{Aa}	0.432± 0.031^{Ba}	0.304± 0.044^{Ba}
NO_3 - N	**F**	0.222± 0.065^{Db}	0.323± 0.008^{Cb}	0.413± 0.011^{Bb}	0.292± 0.015^{CDb}	0.515± 0.037^{Ab}	0.289± 0.015^{CDb}
	D	0.34± 0.063^{Ca}	0.412± 0.015^{BCa}	0.495± 0.015^{Ba}	0.403± 0.025^{BCa}	0.71± 0.036^{Aa}	0.383± 0.013^{Ca}
OP	**F**	0.286± 0.037^{Bb}	0.43± 0.014^{Aa}	0.452± 0.02^{Aa}	0.432± 0.017^{Aa}	0.168± 0.017Ca	0.179± 0.034^{Ca}
	D	0.427± 0.016^{Aa}	0.466± 0.017^{Aa}	0.522± 0.026^{Aa}	0.514± 0.056^{Aa}	0.233± 0.043^{Ba}	0.213± 0.029^{Ba}

Means followed with different capital letters in the same row and different small letters in the same column for each parameter are significantly different.
F = fresh water treatment – D = drainage water treatment

Un-ionized ammonia (NH_3^+):

With the exception of November, un-ionized ammonia values recorded during different months in both treatments were significantly (P<0.05) similar. Results revealed that un-ionized ammonia values recorded in drainage water treatment during all months except October were significantly (P<0.05) higher than those values recorded in fresh water treatment. These values in fresh water treatment ranged between 0.185 and 0.35 mg/l while in drainage water treatment ranged between 0.304 and 0.693 mg/l. El-Sheekh *et al.* (2010) recorded that the concentrations of different nitrogenous compounds in drainage water (Hadous drain) were significantly higher than their concentrations in fresh water (River Nile).

Nitrate – Nitrogen (NO_3 - N):

Nitrate nitrogen values in both treatments showed gradually significant (P<0.05) increase during the first three months before being decreased during November until re increased and reached its maximum values during December were its concentrations were 0.515 and 0.71 mg/l in fresh water and drainage water treatments, respectively, while the lowest concentrations in both treatments were during August wit a concentrations of 0.22 and 0.34 mg/l, respectively. Obtained results showed nitrate nitrogen values recorded in drainage water treatment were significantly (P<0.05) higher than those values recorded in fresh water treatment. Obtained data for nitrate nitrogen recorded in both treatments revealed that these values were below the maximum level mentioned by OATA (2008) which recommends that nitrate levels in freshwater systems do not exceed those in the tap water supply by more than 50mg/l. Obtained date also were within the target NO_3 – N range recommended by the South African Water Quality Guidelines (1996) which stated to be below 300 mg/l.

Ortho phosphates (OP):

Ortho phosphates values in fresh water treatment ranged between 0.168 mg/l which recorded during December and 0.452 mg/l which recorded during October. Its concentrations in drainage water treatments ranged between 0.213 mg/l during January and 0.522 mg/l during October. OP values during the last two weeks in both treatments were significantly ($P<0.0$) lower than its values during the other months. With the exception of August, there were no significant ($P<0.05$) differences between OP values recorded in fresh water treatment and those recorded in drainage water treatment. It could be observed that the increased ortho phosphates values in both treatments were recorded in months in which increased phytoplankton growth were observed. Li and Yakupitiyage (2003) mentioned that limited availability of elementary nutrients in a natural pond can limit primary productivity. Bush and Austin (2001) mentioned that phosphorus is responsible for algal blooms in surface waters.

Plankton assessment:

Phytoplankton:

Total phytoplankton count in the two investigated treatments alongside the study period was summarized in Table 2. Obtained data revealed that the highest count was recorded during September in both treatments. Average total phytoplankton count that recorded in agricultural drainage water treatment was higher than that recorded in fresh water treatment. The increased total phytoplankton count in drainage water treatment could be attributed to the increased nutrient concentrations recorded in this treatment. Numerous studies have identified a strong correlation between phytoplankton biomass and total phosphorous (Drenner *et al*. 1989, 1990; Lancaster and Drenner 1990; Holz and Hoagland 1996). Pradhan *et al.* (2008) reported that Sewage is added to the fishpond to stimulate sufficient plankton growth for fish feed. Rahman *et al*. (2008) indicated that all groups of phytoplankton in the pond water were positively correlated with all nitrogen and phosphorus species. Fact that planktons have a major role in bioremediation increases the potential of using agricultural drainage water. Many authors mentioned the role of plankton in waste and drainage waters bioremediation and clarity (Mehta, 2005; Ibrahim and Gamila, 2004 and Voltonica *et al*., 2005).

Table 2: Phytoplankton total count (org. X 10^3/l) in the two investigated treatments alongside the study period.

	Treatment	
	Fresh water	**Agricultural drainage water**
August	285	296
Sept.	1200	1365
Oct.	810	1130
Nov.	280	310
Dec.	360	450
Jan.	310	310
Total average	540.8	643.5

Phytoplankton community composition:

Percentages of each of the main four phytoplankton divisions were calculated to obtain an idea about the community composition in the both investigated treatments alongside the study period. These data illustrated in charts 1 and 2. In fresh water treatment Blue green algae was predominated the other divisions with a percentage of 45.15 % followed by Green algae which its percentage was 43.91 % followed by Diatoms and Euglena with percentages of 8.17 and 2.77 %, respectively. Community composition in agricultural drainage water had the order Green algae > Blue green algae > Diatoms > Euglena where there percentages were 57.37, 26.47, 13.96 and 202 %, respectively. El-Sheekh *et al* 2010 reported that the predominance of Cyanophyta was due to the high N and P content of Hadous Drain water. Dhawan and Kaur, (2002) reported that the combined action of nitrogen and phosphorus stimulates high production as dominance of Cyanobacteria in the fish farm. Deyab, *et al*. (2002) mentioned that Cyanophyta and Chlorophyta predominated with high nitrogen content of water. Akpan and Okafor (1997) and Paerl and Tucker (1995) reported the development of cyanobacterial bloom to be favoured under conditions of high nutrient loading. With the use of organic fertilizer as primary nutrient source, long culture periods should be avoided to minimize the dominance shift to blue green algae (Osuji *et al*. 2003).

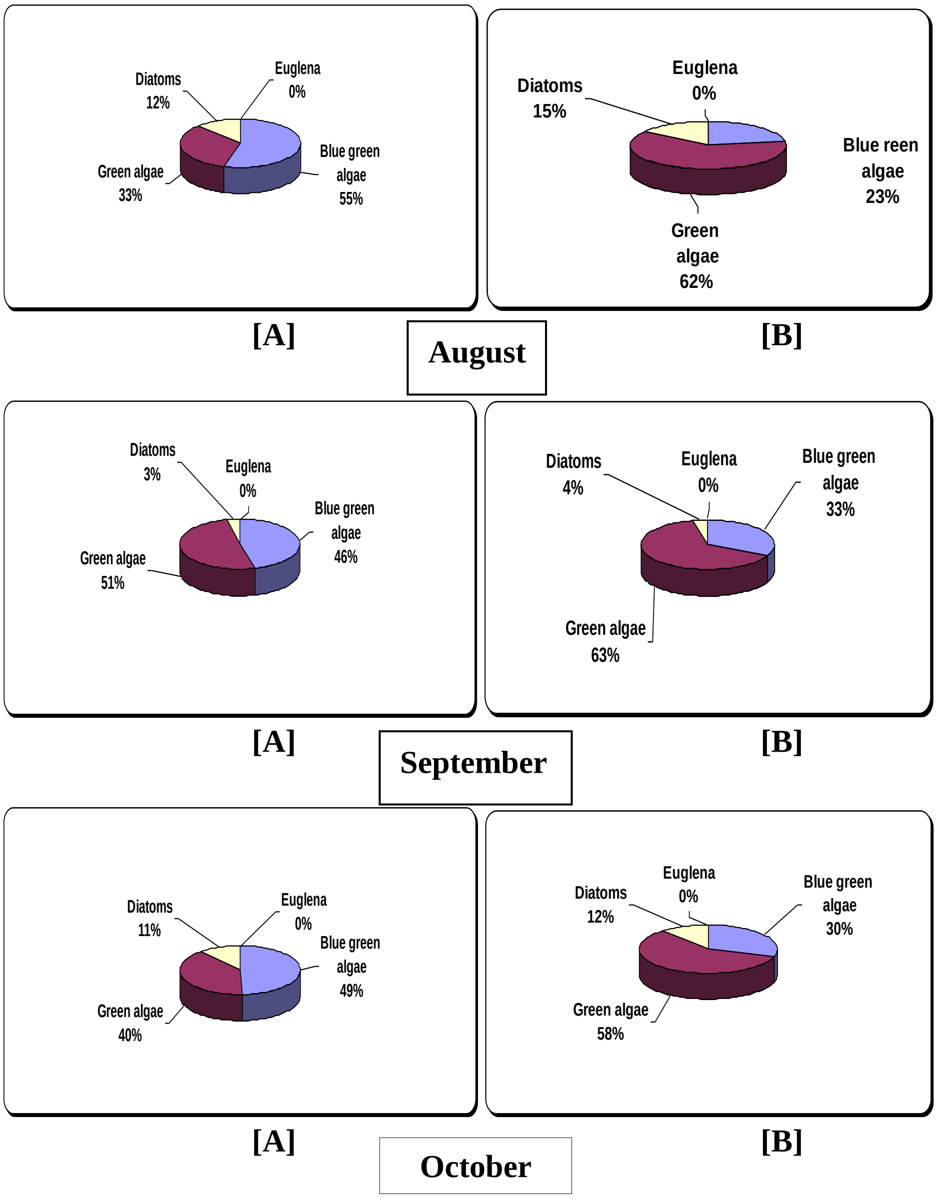
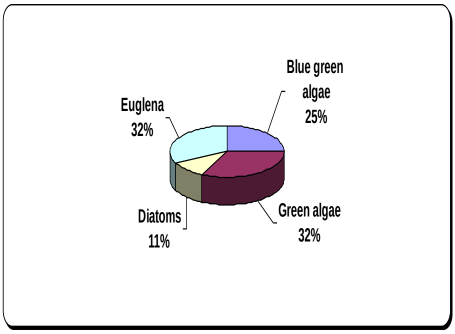
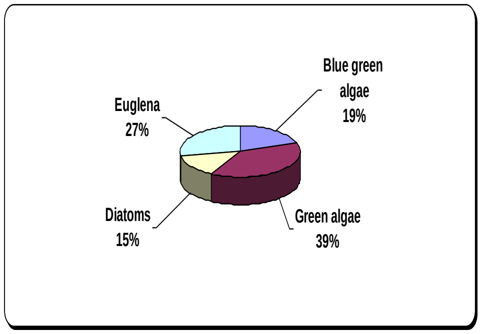
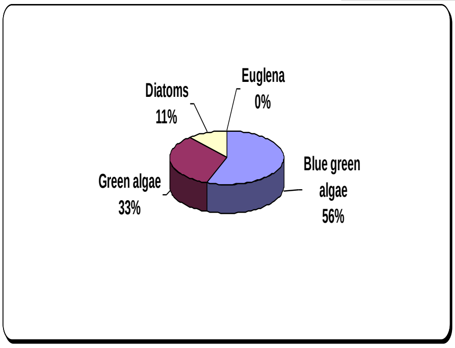


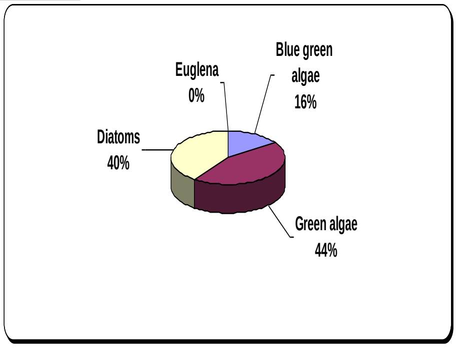
Chart 1: Phytoplankton community composition in fresh water (figures A) and in drainage water (figures B) during different months.



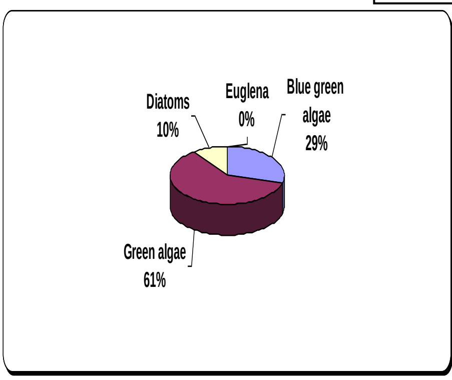


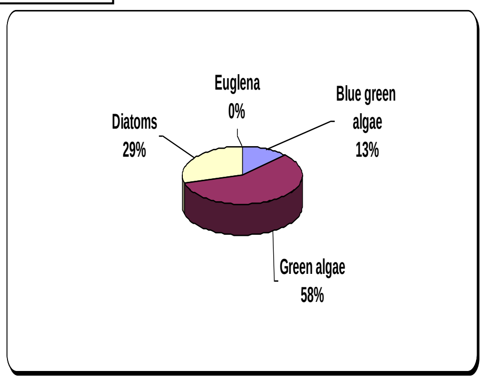
[A] **November** [B]





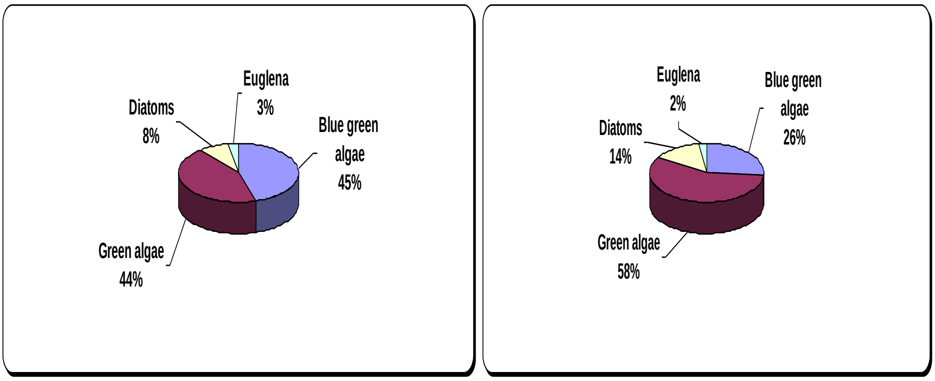
[A] **December** [B]





[A] **January** [B]

Chart 1: continue



[A] **Total average** [B]

Chart 2: Total average of Phytoplankton community composition in fresh water (figures A) and in drainage water (figures B).

Zooplankton:

Total zooplankton count in the two investigated treatments alongside the study period was summarized in Table 3.

Table 3: Zooplankton total count (org./l) in the two investigated treatments alongside the study period.

	Treatment	
	freshwater	**Agricultural drainage water**
August	72	121
Sept.	33	75
Oct.	1720	1967
Nov.	49	85
Dec.	56	82
Jan.	42	47
Total average	328.67	396.17

Obtained data revealed that the highest count was recorded during October in both treatments which could be attributed to the increased phytoplankton growth during September and October. Several studies carried out in freshwater environments have established that the growth of phytoplankton may be controlled to a large degree by the limitation of nutrients, availability of light and the composition and abundance of zooplankton (Basualto *et al*., 2006). Average total zooplankton count that recorded in agricultural drainage water treatment was higher than that recorded in fresh water treatment where these values were 396.17 and 328.67 org./l, respectively. The increased total zooplankton count in drainage water treatment could be attributed to the increased nutrient concentrations recorded in this treatment. Rahman *et al*. (2008) indicated that all groups of zooplankton in the pond water were positively correlated with all nitrogen and phosphorus species.

Zoo plankton community composition:

Percentages of each of the main four zooplankton divisions were calculated to figure out the community composition in the both investigated treatments alongside the study period. These data illustrated in charts 2 and 3. *Rotifera* dominated the other taxonomic divisions in fresh water treatment with a percentage of 43.2 %, followed by *Cladocera*, *Copepoda* and then *Ostracoda* with percentages 32.56, 22.67 and 1.57 %, respectively. In drainage water treatment *Cladocera* was the dominant division with a percentage of 43.3 % followed by *Rotifera*, *Copepoda* and then *Ostracoda* with percentages of 36.4, 19.25 and 1.04 %, respectively. Rotifers percentage in fertilized freshwater treatment was higher than its percentage in non fertilized drainage water, which could be explained by the fact that organic fertilizer increases the growth of smaller sized zooplankton (*Rotifera*) as previously mentioned by Okojin and Obi (1999). In addition to the fact that copepods served as major food for the fish than other zooplankton (Hong *et al*., 1994). The different in zoo community composition between the two investigated treatments could be attributed also to the different between them in phytoplankton community composition. Macedo and Pinto-Coelho

(2001) mentioned that algal communities affect zooplankton community structure.

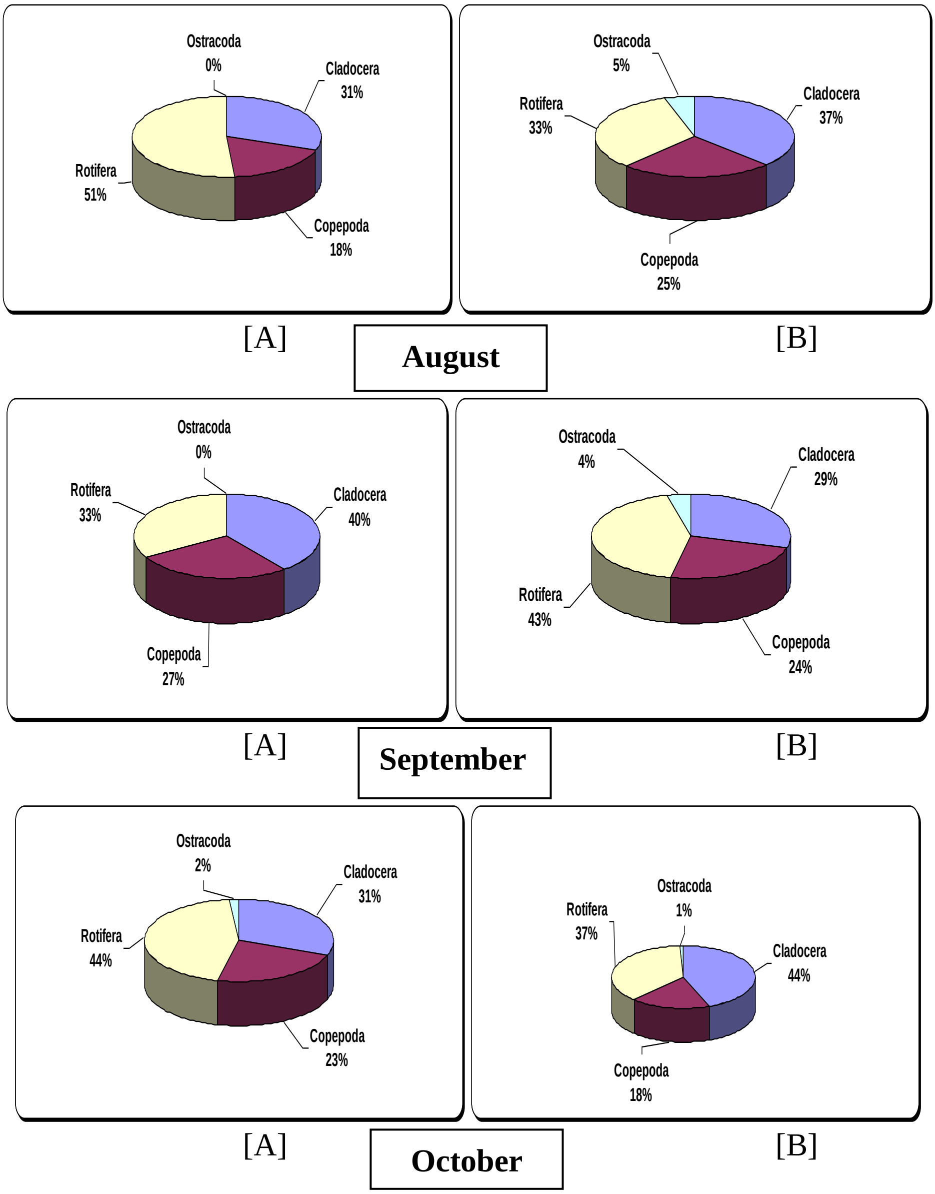
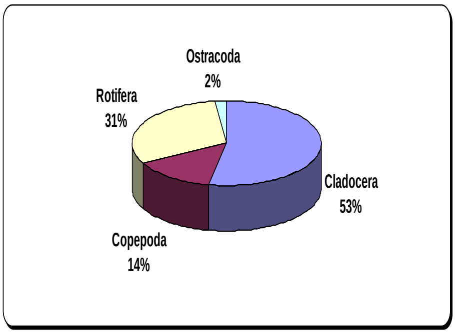
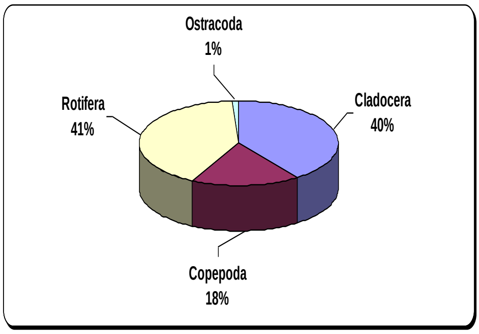
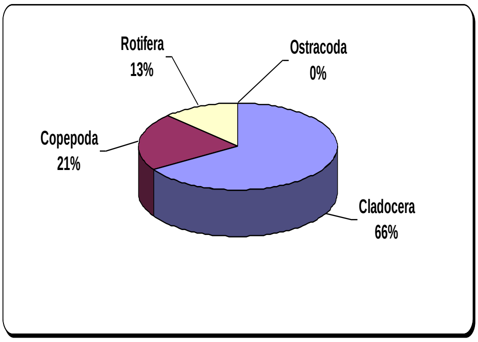


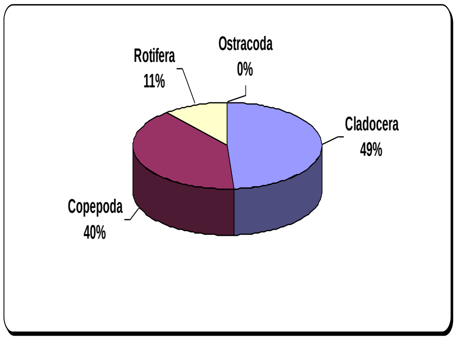
Chart 3: Zooplankton community composition in fresh water (figures A) and in drainage water (figures B) during different months.



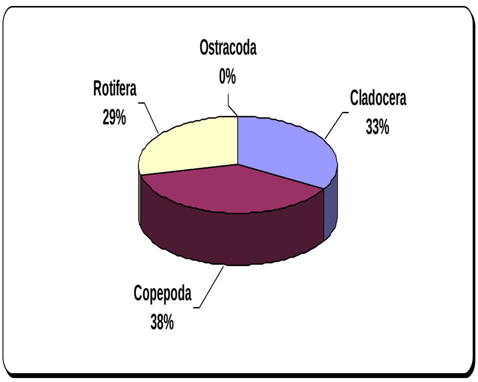


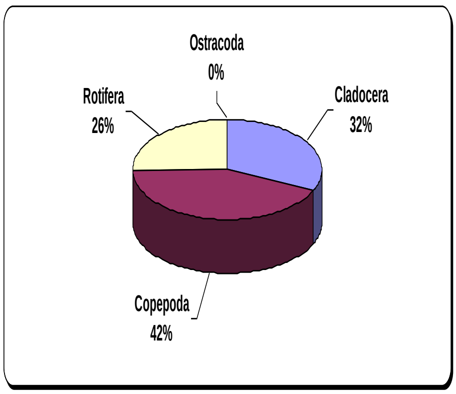
[A] **November** [B]





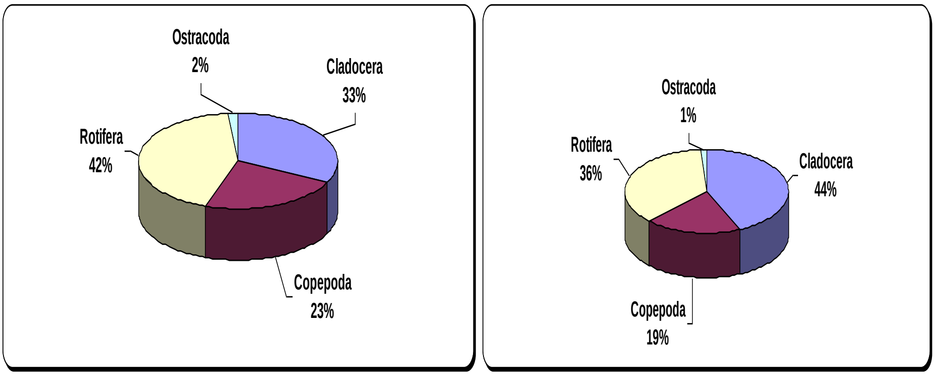
[A] **December** [B]





[A] **January** [B]

Chart 3: continue



[A] **Total average** **[B]**

Chart 4: Total average of zooplankton community composition in fresh water (figures A) and in drainage water (figures B).

CONCLUSION

Obtained results through the present study showed that most physical and chemical characteristics were within acceptable ranges for fish culture. In comparison to fresh water, agricultural drainage water increased phyto and zooplankton total count, providing natural food for pond fishes. In contrast to fresh water treatment, in which the un-preferred Cyanophyta was dominated the other phytoplankton taxonomic divisions, the preferred Chlorophyta was the dominated one. Upon these results, utilizing agricultural drainage water for earthen fish ponds irrigation could be recommended.

It could be concluded that mixing fresh water with agricultural drainage water could be considered a useful practice, through utilizing much needed volumes of water required for the increased developed fish farms. Same conclusion recommended by Osman *et al* (2010) who stated that agricultural drainage water may be used as fish feeding source.

REFERENCES

Akpan, F. R. and Okafor, N. 1997. On organic fertilization and plankton development in two experimental freshwater ponds of Nigeria. Aqua. Trop., 12: 147 - 154.

APHA. 1985. Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D.C., 1268 pp.

Bailey, N. 1982. Statistical methods in biology, 2nd ed. John Wiley, New York.

Basualto, S.; J. Tapia; F. Cruces; C. Bertran; R. Shzatter; F. Pena-Cortes and E. Hannstein. 2006. The effect of physical and chemical parameters on the structure and composition of the phytoplankton community of Lake Budi (IX Region, Chile). *J*. of the Chilean Chem. Soc., 51 (3): 993-999.

Boyd, C.E. 1990. Water Quality in ponds for aquaculture. Agriculture Experiment Station, Auburn Univ., Alabama, U.S.A, 482 pp.

Boyd, C.E. 1982. Water Quality Management for Pond Fish Culture. Elsevier, Amsterdam, 318 PP.

Bush, B.J. and N.R. Austin. 2001. Timing of phosphorus fertilizer application within an irrigation cycle for perennial pasture. J. Environ. Qual., 30: 939–946.

Bwala, R.L. and E. Omoregie. 2009. Organic enrichment of fish ponds: Application of Pig Dung vs. Tilapia Yield. Pakistan Journal of Nutrition, 8 (9): 1373 – 1379.

Chan, G.; L.T. Hung and N.V. Thu. 1993. National Seminar on Sustainable livestock production on local resources. pp: 2-10.

Davies, O. A.; J. F. Alfred-Ockiya and A. Asele. 2006. Induced growth of phytoplankton using two fertilizers (NPK and agrolyser) under laboratory conditions. African J. of Biotech., 5 (4): 373-377.

Deyab, M. A.; M.M. Nemat Alla and F.M. El-Adl. 2002. Phytoplankton diversity in some ponds at New Damietta – Egypt. *Egyptian* J. of Phycol., 3: 1-15.

Dhawan, A. and S. Kaur. 2002. Pig Dung as pond manure: Effect on water quality, pond productivity and growth of carps in polyculture system. Naga, the ICLARM Quarterly, 25 (1): 11 –14.

Drenner, R.W.; J.D. Smith; J.R. Mummen and H.F. Hcaster. 1990. Responses of a eutrophic pond community to separate and combinedeffectsofN:Psupplyand planktivorousfish: amesocosm experiment. Hydrobiol., 208:161-167.

Drenner, R.W.; S.T. Threlkeld; J.D. Smith; J.R. Mummert and P.k. Cantrell. 1989. Interdependenceof phosphorus, fish and site effects on phytoplankton biomass and zooplankton. Limnol. Oceanogr. 34: 1315-1321.

Dupree, H.K. and J.V. Huner 1984. Third Report to the Fish Farmers: The Status of Warm water Fish Farming and Progress in Fish Farming Research. U.S. Fish and Wildlife Service, Washington, DC, 270 pp.

El Naggar, G.O.; N.A. Ibrahim and M.Y. Abou Zead. 2008. Influence Of Fertilizers' Types And Stocking Density On Water Quality And Growth Performance Of Nile Tilapia- African Catfish In Polyculture System. 8th International Symposium on Tilapia in Aquaculture 2008.

El-Gamal, F. 2007. Use of non conventional water resources in irrigated agriculture. Proceedings of the International Conference, Water

Saving in Mediterranean Agriculture & Future Research Needs, 14-17 February - Valenzano, (Italy).

El-Sayed, A.E.M. and M. Kawanna. 2008. Optimum water temperature boosts the growth performance of Nile tilapia (Oreochromis niloticus) fry reared in a recycling system. Aquaculture Research, 39: 670- 672.

El-Sheekh, M.M.; M.A.I. Deyab,; S.S. Desouki and M. Eladl. 2010. phytoplankton compositions as a response of water quality in El Salam canal Hadous drain and Damietta branch of River Nile Egypt. pak. j. bot., 42 (4): 2621-2633,

Holz, J.C. and K.D. Hoagland. 1996 Experimental microcosm study of the effects of phosphorus reduction on plankton community structure. Can. J. Fish. Aquat. Sa., 53: 17541764.

Hong, S.Y.; C.W. Ma and Y.S. Kang. 1994 Distribution of copepod indicator species and zooplankton communities in Pusan Harbor, Korea. J. Kor. Oceanogy. Soc., 29: 132-144.

Ibrahim, M.B.M. and H.A. Gamila. 2004. Algal bioassay for evaluating the role of algae in bioremediation of crude oil; Bull. Envioron. Contam. Technol., 73 (5): 883-889.

Knud-Hansen, C.F. 1998. Pond fertilization: Ecological approach and practical application. Pond Dynamica/Aquaculture CRSP, Oregon State University, Corvallis, Oregon.

Kumar, M.S.; T.T. Binh; S.N. Burgess and L.T. Luu. 2005. Evaluation of optimal species ratio to maximize fish polyculture production. Journal of Applied Aquaculture, 17 (1): 35 – 49.

Lankaster. H.F. and R.W. Drenner. 1990. Experimental mesocosm study of the separate and interaction effects of phosphorus and mosquito fish (GumbucMaflnk) on plankton communityshucture. Can. J. Fish. Aquat Sa., 47: 471479.

Li, L. and L.L. Yakupitiyage. 2003. A model for food nutrient dynamics of semiintensive pond fish culture. Aquacultural Engineering, 27: 9 – 38.

Macedo, C.F. and R.M. Pinto-Coelho. 2001. Nutritional status response of *Daphnia laevis* and *Moina micrura* from a tropical reservoir to different algal diets: *Scenedesmus quadricauda* and *Ankistrodesmus gracilis*. Brazilian Journal of Biology 61 (4): 555-562.

Magouz, F.I.; S.A. Mahmoud and Z.M. Abo-omer 1999. Effect of chemical fertilizer of the productivity of fish in poly-culture earthen ponds. Egyptian journal of Nutrition and Feeds. 2 (special issue): 743-751.

Mehta, S.K. 2005. Use of algae for removing heavy metal from waste water. Crit. Re. Biotechnol. 25 (3): 113-152.

OATA, (Ornamental Aquatic Trade Association). 2008. water quality criteria. Registered Office Wessex House.

Okojin, V.A. and A.W. Obi. 1999. Effects of three fertilizer treatments on zooplankton productivity in plastic tanks. Indian Journal of Animal Science, 69 (5): 360-363.

Osman, M.A.; M.A.M. Mohamed; M.H.H. Ali and A.D.G. Al-Afify. 2010. Assessment of Agriculture Drainage Water Quality to be Used for Fish Farm Irrigation. Nature and Science 8 (8): 60-74.

Osuji, C.N.; J.A. Ockiya and A.C. Chinda. 2003. Domnance shiift of phytoplankton in relaton to different organic fertiuzer treatments in *Clarias Gariepinus* culture. In proc. Of the conf. of Fisheries Soc. Of Nigeria (FISON) Owerri., pp 62-66.

Padmavathi, P. and M.K.D. Prasad. 2007. Studies on algal bloom disasters in carp culture ponds. Braz. J. Morphol. Sci, 24(2): 32–43.

Paerl, H.W. and C.S. Tucker. 1995. Ecology of blue green algae in aquaculture ponds, Journal of the World Aquaculture Society, 26 (2): 109-131.

Pradhan, A.; P. Bhaumik; S. Das; M. Mishra; S. Khanam; B.A. Hoque; I. Mukherjee; A.R. Thakur and S.R. Chaudhuri. 2008. Phytoplankton Diversity as Indicator of Water Quality for Fish Cultivation American Journal of Environmental Sciences, 4 (4): 406-411.

Rahman, M.M; A.J. Leopold; L.A.J. Nagelkerke; M.C.J. Verdegem; M. AbdulWahab; J.A.J. Johan Verreth. 2008. Relationship among quality, food resources, fish diet and fish growth in polyculture ponds: A multivariate approach. Aquaculture, 275: 108 – 115.

Ray, C.S.; M. Mishra; P. Nandy and A.R. Thakur. 2008. Waste management: A case study of ongoing traditional practices at East Calcutta Wetland. Am. J. Environ. Sci., 4 (2): 140-144.

Ray, C.S.; S. Salodkar; M. Sudarshan and A.R. Thakur. 2007. Integrated Resource Recovery at East Calcutta Wetland how safe is these? Am. J. Agric. Biol. Sci., 2: 75-80.

Rowest, C.W.J. 1998. Regional water distribution in the Nile Delta of Egypt. Ilri workshop: Water and food security in semi-arid areas, proceedings of the Wageningen water workshop.

South African Water Quality Guidelines. 1996. Volume 6: Agricultural Water Use: Aquaculture, Second Edition.

Voltonica, D.; H.G. Villa and G. Correa. 2005. Nitrogen removal and recycling by *Scenedesmus obliqqus* in semi continuous cultures using artificial wastewater and a simulated light and temperature cycle. Bioresour. Technol., 96 (3): 359- 362.

إختبار مدي كفاءة إستخدام مياه الصرف الزراعي كمصدر لري أحواض الأسماك الترابيـة

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الملخـص العربـى

أجريت هذه الدراسة في كل من المعمل المركزي لبحوث الثروة السمكية والمركز الدولي للأسماك بالعباسة – أبو حماد – محافظة الشرقية – مصر بهدف بيان كفاءة إستخدام مياه الصرف الزراعي كمصدر للري في أحواض الاستزراع السمكى وقد استخدمت فى هذه الدراسة عدد (٦) أحواض ترابية مساحة كل منها (١) فدان قسمت الى مجموعتين كل منها تضم ثلاثة أحواض كان مصدر المياه فى المجموعة الاولى هو ترعة جدعون المشتقة من ترعة الاسماعيلية بينما كان مصدر المياه فى المجموعة الثانية هو مصرف البهنساوى وقد تم تسميد أحواض المجموعة الاولى بزرق الدواجن بمعدل ٣٠٠كجم افدان اأسبوع بينما لم تتلقى أحواض المجموعة الثانية أى أسمدة . تمت تغذية أسماك تلك المجموعتان باستخدام علف صناعى يحتوى على ٢٥% بروتين بمعدل ٣% من وزن الكتلة الحية يوميا.

وقد بينت الدراسة امكانية الاستفادة من مياه الصرف الزراعى كمصدر للرى فى احواض الاستزراع السمكى حيث كانت قراءات كل الاختبارات الفيزيقية و الكيميائية لعوامل جودة المياه فى حدود النسب المسموح بها للاستزراع السمكى بينما زاد العد الكلى للهائمات النباتية و الحيوانية فى معاملة الصرف الزراعى عنه فى معاملة مياه الترعة المسمدة و كذلك بالنسبة للتركيب المحصولى للهائمات النباتية .

أوضحت النتائج سيادة الطحالب الخضراء فى معاملة الصرف الزراعى عنها فى مياه الترعة المسمدة وهى من الأنواع المفضلة بالنسبة للأسماك . بينما فى معاملة مياه الترعة كانت الطحالب الخضراء المزرقة هى السائدة و التى قد تكون ضارة بالنسبة للأسماك . و بالتالى فبناءا على النتائج المتحصلة توصى هذه الدراسة بامكانية الاستفادة من مياه الصرف الزراعى كمصدرللرى فى أحواض الاستزراع السمكى.