# Impact of organic fertilization systems on water quality, phytoplankton population and fish production in earthen ponds



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# IMPACTS OF ORGANIC FERTILIZATION SYSTEMS ON WATER QUALITY, PHYTOPLANKTON POPULATION AND FISH PRODUCTION IN EARTHEN PONDS

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*ABSTRACT*

This study carried out to evaluate the influence of two application system of chicken manure fertilizer in earthen ponds on water quality, phytoplankton population and fish production. This experiment was conducted in six earthen ponds 10000 $m^2$ each at Al-Tal-Elkaber area, Ismalia, Egypt. Ponds were divided to two groups; the first group (treatment 1: three replicate ponds) was fertilized by 2000 kg chicken manure/pond (before filling ponds with water) and after 8 weeks a 50 kg chicken manure/pond were added daily for 5 days/week until the end of experiment. The second group (treatment 2: three replicate ponds) was fertilized by 100 kg chicken manure/pond, 5 days/week for 12 week. The diet containing 25% protein was used to feed the fish in the two groups after 12 week at rate 3% of fish/wt. The stocking rate was 27000 Nile tilapia (*Oreochromis niloticus*) fry mono sex average initial weight 5 gm and 2000 gray mullet (Tobara) (*Liza ramada*) with average weight 30.0 gm (fingerlings). The fish were harvested and weighed after 24 week. The results indicate that significant difference was present between the two application systems in $NH_4$-N, $NO_3$-N, total nitrogen, total phosphorus, pH, TDS, BOD and chlorophyll "a", phytoplankton and zooplankton except the EC. Treatment 1 had highest values of water quality items, plankton abundance and growth performance of fish. The different taxa of phytoplankton cyanophycea (blue green algae) and the chlorophycea (green algae) were the dominant phytoplankton groups in the two treatments and followed by euglinophycea and bacillariophycea (diatoms). The high addition of manure in treatment 1 affect on the fish production of Tilapia and Mullet as well as FCR, survival, Revenue and net profit.

From these results, it is obvious that, the two applications systems of manure were suitable for tilapia and mullet production in fishponds in Egypt and the investor can chose the suitable application according to the available conditions.

## INTRODUCTION

The goal of pond fertilization can be viewed simply as maximizing the casual link between fertilizer inputs and ultimate yields of culture organisms at harvest, while minimizing economic costs and environmental pollution. This general goal encompasses the specific objectives in fertilization theory; increase natural food production by stimulating algal productivity, optimize nutrient utilization efficiency to optimize cost efficiency and to maintain a favorable growth environment for cultured species (**Colman and Edwards, 1987**; **Schroeder et al., 1990**). Furthermore, adding additional manure for purposes of direct consumption may unnecessarily degrade the quality of pond water. Manures can be beneficial in providing algal nutrients to stimulate primary productivity, and decisions to add manure should be based on its utility for producing natural foods. Daily input of fertilizer is likely the best way to keep N, P high (**Milstein et al., 1995**), but labor costs may make this option impractical. Application rates of manures usually should not exceed 50 to 75 kg dry matter/ha per day in un-aerated ponds because of the danger of oxygen depletion. Daily applications of manures are most effective, but weekly applications can be successful (**Boyd 1990**) Optimal fertilization rate is the amount of organic matter that can be cost-effective and utilized in a pond ecosystem without having any harmful effect on water quality as well as on fish growth. This is one of the most important aspects of pond management as excess fertilizer is not only expensive but is also responsible for nutrient enrichment in water bodies. Manure is converted into fish flesh either by direct consumption of feed remains in the manure or stimulation of pond ecosystem to increase autotrophic and heterotrophic production (**Wohlfarth and Hulata, 1987**).

Successful management of tropical fish ponds for biologically optimal fish growth requires provision of necessary nutrients in a balanced manner via fertilization and supplementary feeding. Fertilization provides exogenous elementary nutrients (carbon, nitrogen and phosphorus) for enhancing natural food productivity for omnivorous fish like Nile tilapia, while supplementary feeding provides exogenous food nutrients (energy, protein, etc.) compensating for the nutritional deficit of natural food.

Nile tilapia (*Oreochromis niloticus*) is one of the most popular species cultured in many tropical countries including Egypt. Nile tilapia is commonly grown in semi-intensive culture using fertilization to increase primary production and fish food (**Boyd, 1976; Diana et al., 1991**). A significant portion of increased fish yield following the successful addition of fertilizers is generally due to the growth of algae and the subsequent transformation of algae to fish flesh through food webs of ponds (**McNabb et al., 1990**). **Hepher (1988)** and **Schroeder et al. (1990)** reported that natural food contributed between 300 and 500 g/kg) of growth when tilapia were supplemented with artificial feeds in fertilized ponds.

The protein content of natural food ranges between 550 and 700 g/kg on a dry matter basis (**Hepher, 1988**). This is well above the range (270–350) g/kg recommended for intensive culture of Nile tilapia (**Jauncey 1982; Al-Hafedh and Siddiqui 1999**). However, natural food is deficient in non-protein energy (**Edwards et al. 2000**), leading to part of the natural food protein being catabolized for energy supply.

The physical, chemical and biological characteristics of fertilized fish ponds plus availability and cost of fertilizers are factors that affect the use of fertilizers for optimum fish yield in aquaculture, water quality determines to a great extent the success or failure of a fertilizer application for aquaculture ponds. Fish growth rate is a function of the summation of the parameters either separately or in collection being affected by fertilizers, physical, chemical phytoplankton conditions in water (**Garg and Bhatnagar, 1996**). So, it was very important to study all these factors and their effects on the biological productivity in ponds water looking for the ideal conditions for fish growth and production.

## MATERIAL AND METHODS

This experiment was conducted in six earthen ponds 10000 $m^2$ at Al-Tal-Elkeber area, Ismalia, Egypt during 15/5/2007 to 15/11/2007 (about 180 days). Ponds were drained, cleaned and supplied by fresh water from Ismalia canal (branched from Nile River) and water level was maintained at depth of approximately 1m. Supply and drainage pipes were equipped by nylon screen to prevent fish escape and/ or entry; ponds were randomly assigned to triplicate ponds divided into two groups; the first group (treatment 1) were fertilized by 2000 kg chicken manure/pond at the beginning (before filling ponds with water) and after 8 week manure was added daily at 50 kg chicken manure/pond, 5day/week until end of experiment (which expanded for 24 weeks), the second group (treatment 2) were fertilized by 100 kg chicken manure/pond daily, 5 days/week for the first 12 week only. The diet contains 25% protein was used to feed the fish in the two groups after 12 week by 3% fish/wt. The stocking rate was 27000 Nile tilapia (*Oreochromis niloticus*) fry mono sex average initial weight 5.0 gm and 2000 gray mullet (*Liza ramada*) average weight 30.0 gm fingerlings. The fish were harvested and weighed after 24 week.

### Fish stocking and sampling

*O. niloticus* (male fingerlings) were purchased from a commercial fish hatchery. After one week of acclimation in the concrete ponds, experimental fish were stocked at the rate of 3 fish/$m^2$. Fish were allowed to acclimate to pond conditions and mortality once occurred monitored. During the acclimation period, dead fish were replaced with fish of similar size. The initial weight of fish in all treatments was 5.0±1.0g for tilapia and 30.0±5.0 for mullet. A sample of 100 fish from each pond was individually weighed and total length was measured. Fish sampling was done biweekly using a seine net. Sampled fish were individually weighed (g), while total length was measured (cm). At the end of the experiment, ponds were drained and all fish were counted. Fish growth performance and yield were calculated using the following formulae:

(a) Weight gain = final mean weight (g) –initial mean weight (g)

(b) Increase in weight (%) = final weight – initial weight/initial weight x 100.

(c) Gross yield of fish/ feddan = harvested fish weight (kg)/unit area (feddan).

(d) Net yield/fed. = (harvested fish weight –initial fish weight)/unit area (fed.)

(e) Survival rate (%) = (initial number –number of dead fish) / initial number x 100.

(f) Faulton's condition factor = (weight (g) / length$^3$) x 100.

The physico-chemical and biological properties of water ponds were studied through the investigation periods, samples were taken daily, weekly, biweekly and monthly at constant sites of the ponds. A column sampler constructed from a PVC pipe (5-cm diameter, 1.5-m long) was used to collect water samples for chemical analysis and phytoplankton estimation. A stick sampler with an attached 300-mL biological oxygen demand bottle was used to collect water samples from a depth of 10 cm for all other parameters.

Temperature (°C), dissolved oxygen (mg/l), saturation of dissolved oxygen % were measured by oxygen meter Aqua Lytic OX 24, pH by pH meter Orion 543, salinity g/l were measured using a conductivity meter Orion. The above mentioned items (Temp., DO, pH and salinity) were taken every day, 7 days a week, at 09:00 hour throughout the culture period. Secchi disk visibilities (cm), ammonia (mg/l), nitrate (mg/l), total alkalinity as $CaCO_3$ (mg/l), total hardness (mg/l) phosphorus (mg/l) and chlorophyll a µg/l were measured weekly using standard methods (**APHA, 2000**). Also, plankton was estimated once a week as mentioned by **Hall and Moll (1975).**

### Analysis of pond sediments

Pond bottom soils were collected twice (before and after the experiment) to assess organic matter loading. Sediments were dried at 105°C, pulverized, sieved, weighed and ignited in a muffle furnace at 550°C for 8 h (**Ayub and Boyd, 1994**). Percent organic matter was estimated by the loss in weight before and after ignition.

### Statistical analysis

One-way ANOVA and Duncan multiple range test were used to evaluate the significant difference in the concentration of different studied parameters with respect to the two treatments. A probability at level of 0.05 or less was considered significant. Standard errors were also estimated. All statistical analyses were carried out using (**Bailey, 1981**).

## RESULTS AND DISCUSSION

### Water quality parameters

The fertilizer application affected the quality of the water in a number of ways during this experiment as shown in Table 1 and Figs. (1-8). There were significant differences ($P<0.05$) between treatments in pH, oxygen levels, ammonia, nitrite, Secchi disk readings, nitrate, total nitrogen, chlorophyll a as well as phosphorus (total and available). However, there were no significant differences in temperatures and Electric conductivity.

All parameters were within ranges for tilapia and mullet cultures. Water quality in this experiment varied with the system of fertilization by organic manure applied. The temperatures were within the normal range for tilapia and mullet (27-29°C) according to Boyd (1990). The pH values were increased with increasing dose of organic manure, while the dissolved oxygen decreased with increasing dose of organic manure. The average values of pH were 9.24 and 8.40 for treatment 1 and 2 respectively, and dissolved oxygen were 4.5 and 7.17 mg/l respectively. The same trend of dissolved oxygen was observed in Secchi disk readings, while the opposite trend was observed by $NH_4$-N, $NO_3$-N, total nitrogen and total phosphorus.

Generally, the all water parameters in the present experiment were within ranges for tilapia and mullet cultured in fertilized ponds. The increase of temperature led to increase primary production and photosynthesis that involves the uptake of free carbon dioxide from the water and increase the pH values. This case explains the positive correlation between chlorophyll "a" and temperature (**Boyd 1990 and Knud-Hansen, 1998**).

The highest values of pH, $NH_4$-N, $NO_3$-N, total nitrogen, total phosphorus and chlorophyll "a" as well as the lowest values of Secchi disk readings recorded in first and second months in treatment 1 may due to the higher dose of organic manure. Parameters such as temperature, pH, alkalinity, hardness, dissolved oxygen and nutrients (N&P) play an important role in determining phytoplankton productivity in aquatic system (**Wetzel, 1983**). No significant differences in temperature were observed between treatments due to warm climate and shallowness of most tropical fishponds (1m).

It was noticed that there is a negative correlation between temperature and DO, but a positive correlation was existed between temperature and both pH and chlorophyll "a" in the two treatments and the $r^2$ values were 0.40 and 0.63. A positive correlation was also found between pH and chlorophyll "a" and the $r^2$ values were 0.56 and 0.45 but the correlation more significant in treatment 2 than treatment 1. The chlorophyll "a" was positively correlated in treatment 2 with P and negatively with $NO_3$-N but no significant in treatment 1 with P and $NO_3$-N. These conditions of temperature range and chlorophyll "a" concentrations were conducive for growth and propagation of zooplankton, such as Rotifers, Copepoda and Cladocerans as mentioned by (**Karen and Lester, 1995**).

Phytoplankton production in the form of chlorophyll "a" indicated that the higher application of organic chicken manure propagated significantly ($P<0.05$) higher amounts of chlorophyll "a" than lower application, which did not differ significantly from last months. But there were significant differences between treatments in the first two months. The average values of chlorophyll "a" were 181.28 and 136.92µg/l for two treatments respectively. Significantly higher amounts of chlorophyll "a" were recorded in ponds fertilized with high dose of organic fertilizer indicating that there was a higher level of phytoplankton production. This is in consistency with the work reported by **Diana, et al. (1991)** with higher inputs of chicken manure (500 kg/ ha/week).

**Plankton abundance**

Phytoplankton production in the form of chlorophyll "a" indicated that the increasing application organic fertilizer propagated significantly ($P<0.05$) higher amounts of chlorophyll "a" (Table 1). Treatment 2 had a significantly lower amount of chlorophyll "a" during the first two months. The average values of chlorophyll "a" were 181.28 and 136.92 µg/l for the two treatments respectively (Table 1). Significantly higher amounts of chlorophyll "a" were recorded in ponds fertilized with high dose of organic manure indicating that there was a higher level of phytoplankton production. This is in consistency with the work reported by **Diana, et al. (1991)** with higher inputs of chicken manure (500 kg/ ha/week).

**Jeremiah, et al. (2005)** mentioned that, organic fertilizer increase the phytoplankton and zooplankton productivity. Also, there were significant differences in numbers of phytoplankton between treatments especially in first two months. Results of table (1) show that, the highest numbers in phytoplankton recorded in high dose of chicken litter treatment. **Shaker (2008)** reported that the phytoplankton and zooplankton increased with increasing organic chicken manure. He added that copepoda and rotifers were abundant in all organic fertilizer ponds and there was significant increase in fertilized ponds. Also, he reported that the number of zooplankton was higher in chicken manure than others organic fertilizers ponds.

**Soil organic matter loading**

The application of manure in ponds was expected to increase the organic matter loading. In the experiment, the percent organic matter loading was significantly (P<0.05) increased in the two treatments after experiment as shown in table 2. The initial percentage of organic matter in two treatments was 1.02%. The organic matter percentages were gradually increased in treatment 2 during whole period, while sharply increase in treatment 1 during first two months and then gradually increased until the end of experiment. The final percentages of organic matter were 5.12 and 4.56% for two treatments respectively. These results indicated that the highest accumulation of organic matter recorded in treatment 1. The highest accumulation of organic matter in surface layer in treatment 1 may be due to the highest addition of organic manure than in treatment 1. These results are in agreement with those obtained by **Shaker (2008)** who reported that the accumulation of organic matter in surface soil layer depending on the use of manure in pond management, quantity, frequency of manure, phytoplankton cycles, fish species and metabolic processes by fish. The levels of loading were comparable with those reported by Boyd (1990) and **Jeremiah et al. (2005)**. It is reported that pond soils tend to acquire greater organic matter concentration than surface soils and this may increases with organic fertilization (**Boyd 1995**).

The organic matter acts as substrate for the heterotrophic production of microorganisms and protozoans in microbial food webs that can be utilized by fish to obtain the much needed nutrition through natural crops of algae, bacteria and other microorganisms in organically fertilized ponds (**Boyd 1995**). Also, the decomposition of organic matter led to decrease of dissolved oxygen in all treatments. Results of table (2) show that, the percent organic matter loading increases significantly in both treatments with increasing manuring level.

**Growth performance of fish species and some economic parameters:**

From the data presented in table (3), show the initial and final weights of different fish species. The weight of the two fish species did not significantly different at initial and after the first month. While in second month the weight of the two fish species significantly differ until the end of experiment. The average initial weight of tilapia was 5.0 g in two treatments and after one month weights were 35.0 g and 25.0 g for two treatments respectively. Mullet was 30.0 g in two treatments and after one month the weights were 50.0 and 45.0 g, respectively. The weights of the two fish species were gradually increased during experiment, but the increases in fish weight in first treatment were significantly higher than treatment 2. The final weights of tilapia were 195.0 and 145.0 g, while, it was 145.0 and 125.0 g for mullet, respectively.

Also, it was observed that, tilapia showed the highest survival rate in the two treatments than mullet. This trend was also true for weight gains per day 0.92 and 0.64 g/day for tilapia and 0.64 and 0.35 g/day for mullet in two treatments, respectively. Fish in ponds fertilized with high dose of organic fertilizers grew significantly better than fish in the low dose treatments. These results are in agreement with those obtained by **Shaker (2008)** who reported that the total fish production, daily gain of fish and net gain were significantly increased with increasing organic fertilizer input.

The percent increase in weight for *Oreochromis niloticus* was higher for fish in all chicken fertilizer in this experiment compared with those from similar systems where increase was reported for fish in ponds treated with bamboo trunks (**Garg and Bhatnagar, 1996**). Also, the percent increase in weight for *Oreochromis niloticus* was higher in both treatments was higher than mullet in two treatments. These results are in agreement with those obtained by **Diana et al., (1996)** and **Shaker** and **Abdel-Aal (2006)** who reported the highest daily gain was recorded by silver carp followed by catfish and tilapia then mullet. Also they added that the lowest daily gain was recorded in mullet.

The current investigations give highlights on the potential of using organic fertilizers in Nile tilapia and mullet fingerlings in earthen ponds. Generally, the growth responses of fish in two treatments were satisfactory. As presented in table (4) total costs were 2.87 and 2.62 LE/$m^3$ for two treatments respectively and net returns in LE per cubic meter water volume were 1.65 and 0.95 LE for the two treatments, respectively. Percentages of net returns to total costs were 50.48 and 36.16% for the two treatments, respectively.

These results revealed that the highest net returns were reached by fish of treatment 1 followed in a descending order by those in treatment 2.

Table (1): Total average values of water quality parameters in fish ponds treatments during the experimental period.

| Parameters | Treatment 1 | Treatment 2 |
|---|---|---|
| Temperature °C | 27.77A±2.12 | 28.93A±2.01 |
| pH Value | 9.24A+0.29 | 8.40B±0.32 |
| SD Cm | 12.5B±1.4 | 16.5A±1.5 |
| Dissolved Oxygen | 4.5B±1.4 | 7.14A±1.43 |
| Electric conductivity | 0.933A±0.178 | 1.019A±0.271 |
| Chlorophyll "a" | 181.28A±120 | 136.92B±123.14 |
| Total dissolved solid | 0.758A±0.673 | 0.853A±0.637 |
| NH4-N mg/l | 1.7A±0.2 | 1.1B±0.2 |
| NO3-N-N mg/l | 3.8A±0.447 | 2.61B±0.0428 |
| TN mg/l | 20.5A±1.56 | 11.6B±1.1 |
| Total Phosphorus mg/l | 2.065A±1.63 | 1.66B±1.1842 |
| Alkalinity mg/l | 180A±16 | 195A±7 |
| Hardness mg/l | 283A±11 | 273A±17 |
| Total Phytoplankton | 483400A±95874 | 382200A±78653 |

* Values with different letters in the same raw are significantly different ($P<0.05$).

Table (2): Monthly fluctuation of organic matter in soil under different systems of organic fertilizer during the experimental period.

| Months | Treatment 1 | | Treatment 2 | |
|---|---|---|---|---|
| | Before | After | Before | After |
| 1 | 1.02±0.1bz | 2.56±0.33az | 1.02±0.1bz | 1.58±0.16bz |
| 2 | 2.56±0.33cy | 3.72±0.26ay | 1.58±0.16cy | 2.2±0.32by |
| 3 | 3.72±0.26by | 4.02±0.18ay | 2.2±0.32cy | 2.99±0.26by |
| 4 | 4.02±0.18ax | 4.58±0.24ax | 2.99±0.26bx | 3.36±0.28bx |
| 5 | 4.58±0.24ax | 4.96±0.24ax | 3.36±0.28bx | 3.98±0.24bx |
| 6 | 4.96±0.24ax | 5.12±0.33ax | 3.98±0.24bx | 4.56±0.32ax |

Different letters a,b and c in the same raw are significantly different among treatments and x, y and z in the column are significantly different among months in the same treatment ($P<0.05$).

Table 3: Growth performance of Nile tilapia and mullet reared in earthen ponds under different organic fertilizers systems

| Items | Fish species | Treatment 1 | Treatment 2 |
|---|---|---|---|
| | | Weight (g) | Weight (g) |
| Initial | Tilapia | 5±1a | 5±1a |
| | Mullet | 30±3a | 30±3a |
| 2 week | Tilapia | 15±2a | 11±2a |
| | Mullet | 35±2a | 35±2a |
| 4 week | Tilapia | 35±3a | 25±2b |
| | Mullet | 50±3a | 45±3a |
| 2 month | Tilapia | 70±5a | 50±5b |
| | Mullet | 70±5a | 60±5b |
| 4 month | Tilapia | 125±10a | 100±10b |
| | Mullet | 105±10a | 90±8b |
| final | Tilapia | 195±15a | 145±14b |
| | Mullet | 145±12a | 125±12b |
| Net gain g | Tilapia | 165±13a | 115±10b |
| | Mullet | 115±11a | 95±8b |
| Daily gain g | Tilapia | 0.92±0.1a | 0.64±0.1b |
| | Mullet | 0.64±0.1a | 0.53±0.1b |
| Survival rate% | Tilapia | 90±5a | 95±5a |
| | Mullet | 80±5a | 80±5a |
| Production kg | Tilapia | 4738.5±400a | 3719.25±350b |
| | Mullet | 232±15a | 200±15a |
| Total production kg | Tilapia + mullet | 4970.5±425 | 3919.25±365 |

Different letters in the same raw are significantly different between the two treatment (P<0.05).

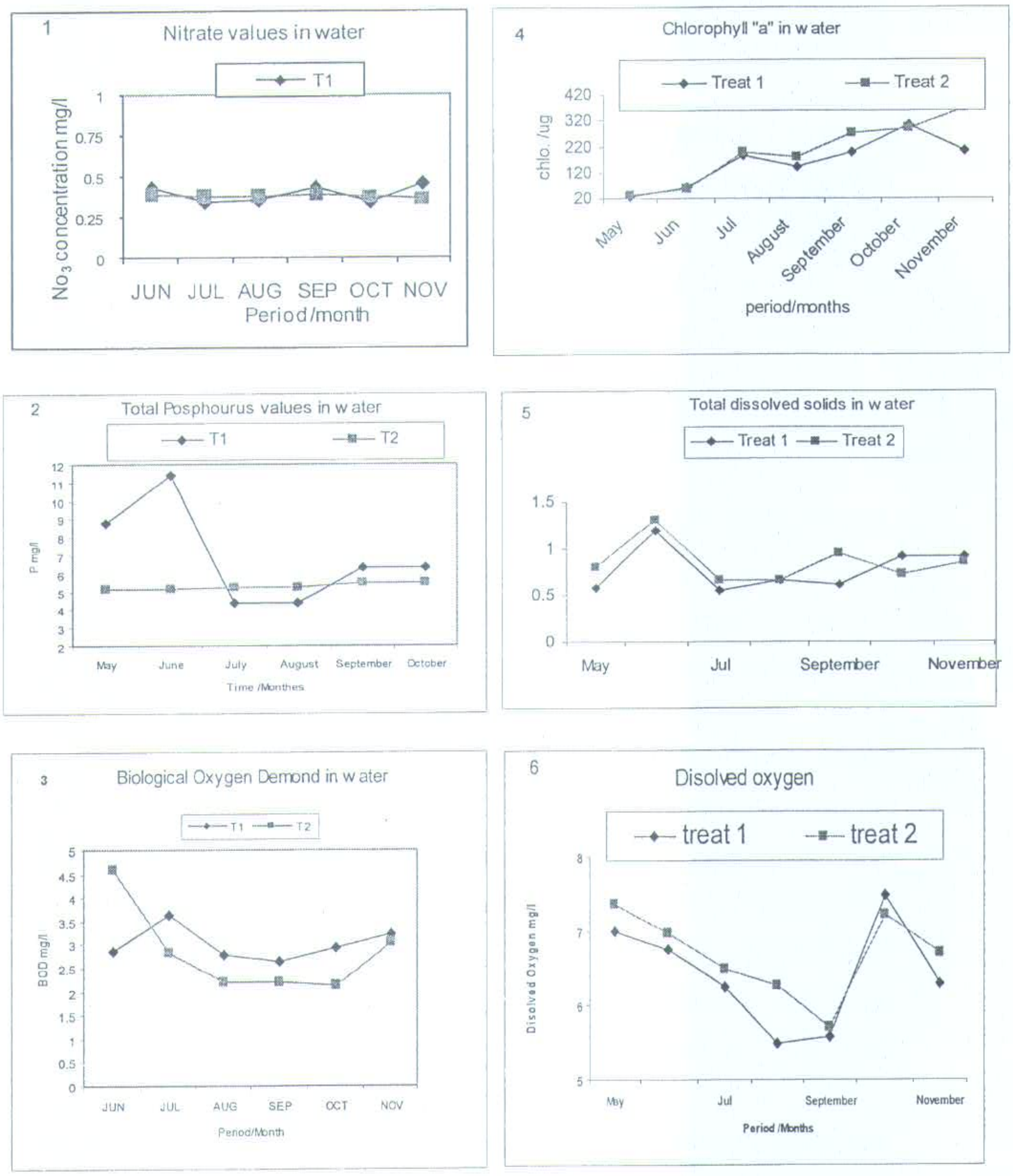
Table (4): economic parameters for Nile tilapia and mullet in earthen pond under two organic fertilizer systems

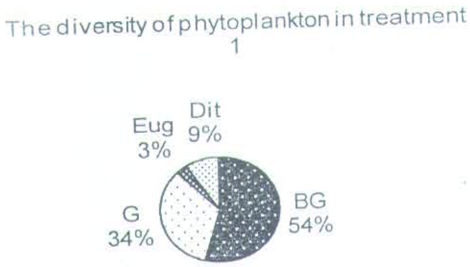
| Items | | Treatment 1 | Treatment 2 |
|---|---|---|---|
| **Variable cost/pond** | | | |
| Price fingerlings | *Tilapia | 2700 | 2700 |
| | *Mullet | 600 | 600 |
| Total price | | 3300 | 3300 |
| Chicken manure | *Ton | 3600 | 3600 |
| Artificial feed | *Ton | 20000 | 17500 |
| Labors | | 1200 | 1200 |
| Total variable cost LE | | 28100 | 25600 |
| **Fixed cost** | | | |
| Depreciation | | 400 | 400 |
| Texas | | 200 | 200 |
| Total fixed cost LE | | 600 | 600 |
| Total costs | | 28700 | 26200 |
| **Returns** | | | |
| Total returns (LE) | *Tilapia | 42646.5 | 33473.25 |
| | *Mullet | 2552 | 2200 |
| Total returns (LE) | | 45198.5 | 35673.25 |
| Net returns (LE) | | 16498.5 | 9473.25 |
| %Net returns to total costs | | 50.48 | 36.16 |

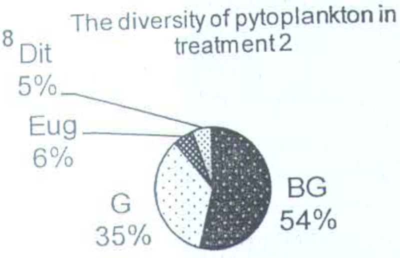
*1000 Tilapia= 100LE, 1000 Mullet= 100LE, Ton chichen manure = 600, Ton artificial feed = 2500,

average price/kg tilapia 9 LE and Mullet 11 LE.

Figs. 1-8: Physico-chemical properties and phytoplankton diversity of pond water in the two treatments in figures



7 


8 


Dia: Diatom (Bacillariophycea); Eug.: Euglenophycea; G: Green algae (Chlorophycea); BG: Blue green algae (Cyanophycea)

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## الملخص العربى

# تأثير التسميد العضوى على جودة المياه ونمو الفيتوبلانكتون وإنتاج الأسماك فى الأحواض الترابية

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فى دراسة لتقييم نظامين من التسميد العضوى بإستخدام زرق الدواجن فى موسم الإنتاج (6شهر) فى الأحواض الترابية. إستخدم فى الدراسة عدد 6 حوض ترابى مساحة كل منها 10000 م2 فى منطقة التل الكبير وتم زراعة كل حوض بعدد 27000 إصبعية بلطى نيلى وحيد الجنس بمتوسط وزن أولى 5 جم وعدد 2000 طوبارة بمتوسط وزن 30جم . وزعت الأحواض عشوائيا على معاملتين لكل منها ثلاث مكررات خلال الموسم. فى المعاملة الأولى تم وضع 2000كجم زرق دواجن قبل ملء الأحواض بالماء ثم بعد شهرين تم اضافة 50كجم يوم/5 أيام/أسبوع حتى نهاية الموسم والمعاملة الثانية يتم اضافة 100 كجم يوم/5 أيام/أسبوع من بداية الموسم ولمدة 12 أسبوع الأولى. بعد 12 أسبوع الأولى تم تغذية الأسماك بالعلف الصناعى (25% بروتين بنسبة 3% من وزن السمكة) وحتى نهاية التجربة. تم قياس درجات الحرارة – الأكسجين – الأمونيا – درجة الأس الهيدروجينى يوميا /5 أيام /أسبوع وأخذ عينة مياه من مواقع ثابتة مرة أسبوعيا لإجراء التحاليل الكيماوية والبيولوجية وكذلك عينات الأسماك كل اسبوعين لتحديد كميات الأعلاف المستخدمة ومعدلات النمو للأسماك. إستخدم فى الدراسة علف صناعى 25% بروتين بمعدل 3% (5أيام/أسبوع) واستمرت الدراسة 180 يوم.

كانت أهم النتائج المتحصل عليها :

زيادة كمية السماد العضوى الأولية أدت إلى زيادة نمو الفيتوبلانكتون وكذلك الى إرتفاع فى كمية الأمونيا والنترات والنتروجين الكلى والفوسفور مما أدى الى زيادة كمية العناصر المغذية خصوصا فى الشهرين الأولى مما أدى إلى زيادة نمو الأسماك فى هذة الفترة فى هذة المعاملة عن المعاملة الأخرى والذى ترتب علية زيادة النتاج النهائى.

تشير الدراسة إلى أن توفر الغذاء الطبيعى فى الفترة الأولى لموسم الزراعة بكميات مناسبة يؤدى إلى زيادة معدلات النمو فى الأسماك مما يؤدى إلى زيادة الإنتاجية السمكية لوحدة المساحة.

أوضحت الدراسة أيضا زيادة التكاليف المتغيرة فى المعاملة الأولى عن المعاملة الثانية نتيجة زيادة كمية العلف الصناعى المستخدمة نتيجة زيادة وزن الأسماك وأن التكاليف الثابتة متساوية فى المعاملتين. أوضحت الدراسة أيضا زيادة صافى العائد فى المعاملة الأولى عن الثانية نتيجة زيادة صافى الوزن. وتوصى الدراسة بإستخدام أى من النظامين من التسميد العضوى فى الإستزراع السمكى.